NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

TAILORING THE SYSTEMS ENGINEERING TECHNICAL REVIEW IMPLEMENTATION WITHIN NAVAL ACQUISITION

by

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September 2017

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REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704–0188
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington, DC 20503.			
1. AGENCY USE ONLY ***(Leave blank)***	**2. REPORT DATE** September 2017	**3. REPORT TYPE AND DATES COVERED** Master's thesis	
4. TITLE AND SUBTITLE TAILORING THE SYSTEMS ENGINEERING TECHNICAL REVIEW IMPLEMENTATION WITHIN NAVAL ACQUISITION			**5. FUNDING NUMBERS**
6. AUTHOR(S) Heather B. Burke			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000			**8. PERFORMING ORGANIZATION REPORT NUMBER**
9. SPONSORING /MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A			**10. SPONSORING / MONITORING AGENCY REPORT NUMBER**
11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government. IRB number 2017.0028-DD-N.			
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release. Distribution is unlimited.			**12b. DISTRIBUTION CODE**

13. ABSTRACT (maximum 200 words)

The systems engineering technical review (SETR) process should be an event- driven process that consists of one or more programmatically independent reviews with defined entrance and exit criteria. The SETR assesses the technical health, requirements accuracy, design maturity, testing effectiveness, and sustainment support over the program life cycle. This thesis focuses on how to tailor the SETR implementation to improve the program's return on investment (ROI). To address the research question, a literature review was performed focusing on SETR-related policy, instructions, and memoranda and a survey was conducted of subject matter experts. Leveraging a tailored SETR implementation provides the necessary structured engineering framework while keeping up with a dynamic software development environment to meet the increasing need for enhanced capability delivered to the warfighter in a shorter timeframe. More than 80% of the survey respondents indicated tailoring was occurring within programs to address specific needs such as leveraging an agile software development model. Factors external to the organization continue to be the primary obstacle no matter the program size. Future naval software acquisition programs should engage leadership, focus on preparation, maintain communication early and often, and educate stakeholders to improve the ROI of the tailored SETR implementation.

14. SUBJECT TERMS SETR, systems engineering, technical review, software, acquisition, tailoring, tailor, policy, return on investment, ROI			**15. NUMBER OF PAGES** 115
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	**18. SECURITY CLASSIFICATION OF THIS PAGE** Unclassified	**19. SECURITY CLASSIFICATION OF ABSTRACT** Unclassified	**20. LIMITATION OF ABSTRACT** UU

NSN 7540–01-280-5500 Standard Form 298 (Rev. 2–89)
Prescribed by ANSI Std. 239–18

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TAILORING THE SYSTEMS ENGINEERING TECHNICAL REVIEW IMPLEMENTATION WITHIN NAVAL ACQUISITION

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MASTER OF SCIENCE IN SYSTEMS ENGINEERING MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
September 2017

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ABSTRACT

The systems engineering technical review (SETR) process should be an event-driven process that consists of one or more programmatically independent reviews with defined entrance and exit criteria. The SETR assesses the technical health, requirements accuracy, design maturity, testing effectiveness, and sustainment support over the program life cycle. This thesis focuses on how to tailor the SETR implementation to improve the program's return on investment (ROI). To address the research question, a literature review was performed focusing on SETR-related policy, instructions, and memoranda and a survey was conducted of subject matter experts. Leveraging a tailored SETR implementation provides the necessary structured engineering framework while keeping up with a dynamic software development environment to meet the increasing need for enhanced capability delivered to the warfighter in a shorter timeframe. More than 80% of the survey respondents indicated tailoring was occurring within programs to address specific needs such as leveraging an agile software development model. Factors external to the organization continue to be the primary obstacle no matter the program size. Future naval software acquisition programs should engage leadership, focus on preparation, maintain communication early and often, and educate stakeholders to improve the ROI of the tailored SETR implementation.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

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LIST OF ACRONYMS AND ABBREVIATIONS

AAP	Abbreviated Acquisition Program
ACAT	Acquisition Category
ASN (RDA)	Assistant Secretary of Navy for Research Development and Acquisition
AT&L	Acquisition, Technology, and Logistics
BTR	Build Technical Review
CAE	Component Acquisition Executive
CDD	Capabilities Development Document
CDR	Critical Design Review
CHENG	Chief Engineer
COTS	commercial off-the-shelf
DASD(SE)	Deputy Assistant Secretary of Defense for Systems Engineering
DOD	Department of Defense
DON	Department of Navy
FD	Fielding Decision
FTR	Fielding Technical Review
GOTS	government off-the-shelf
HW	hardware
NDI	non-developmental item
NIR	NDI Integration Review
IA	Information Assurance
IAT	Independent Assessment Team
IEEE	Institute of Electrical and Electronics Engineers
INCOSE	International Council on Systems Engineering
IPT	Integrated Product Team
JCIDS	Joint Capabilities Integration and Development System
MDA	Milestone Decision Authority
MCSC	Marine Corps Systems Command
NAVAIR	Naval Air Systems Command
NAVSEA	Naval Sea Systems Command

OA	open architecture
OPEVAL	Operational Evaluation
OPTEVFOR	Operational Test & Evaluation Force
OTA	Operational Test Agency
PDR	Preliminary Design Review
POAM	plan of action and milestones
PM	program manager
R&I	risks and issues
RBR	Release Backlog Review
RFA	request for action
RFI	request for information
ROI	return on investment
SE	systems engineering
SEI	Software Engineering Institute
SEP	Systems Engineering Plan
SER	SETR-Lite Engineering Review
SETR	systems engineering technical review
SME	subject matter expert
SoS	system of systems
SRR	Systems Requirements Review
SPAWAR	Space and Naval Warfare Systems Command
SSC LANT	SPAWAR Systems Center Atlantic
SST	SETR Support Team
SW	software
SYSCOM	Systems Commands
TA	Technical Authority
TLR	Top-Level Requirements
TRB	Technical Review Board
TRR	Test Readiness Review

EXECUTIVE SUMMARY

According to the *Naval SYSCOM Systems Engineering Policy* (2009), the systems engineering technical review (SETR) process should be an event-driven process that consists of one or more programmatically independent reviews with defined entrance and exit criteria. The SETR reviews assess the technical health, requirements accuracy, design maturity, testing effectiveness, and sustainment support over the program life cycle. The jointly signed Systems Command (SYSCOM) policy states that the program SETR events along with the event entrance and exit criteria are documented in the Systems Engineering Plan (SEP), which is signed by the program Milestone Decision Authority or other designated authority based on the program Acquisition Category level. The SYSCOM policy notes that event closure normally occurs only after the exit criteria has been met, but the SETR technical review board (TRB) chair must concur with the identified action items along with any plan of action and milestones and/or mitigations. According to the policy, the SETR output ultimately informs the program manager (PM) if the program is technically ready to move on to the next phase of the acquisition process.

From a policy perspective, the Department of Defense (DOD) and Department of the Navy (DON) directives and instructions lay the systems engineering foundation for the naval SYSCOM guidance regarding SETR implementation. In addition, the Navy has emphasized the need to deliver capability versus systems, and acquisition is impacted by this capability vision requiring innovative application of SETR for the system of systems (SoS) or platform level efforts, which traditional SETR is not well structured to support. This thesis provides an explanation of the traditional SETR process implementation within the various naval SYSCOMs. Additionally, this thesis provides an overview of how the SYSCOMs enable major acquisition programs and other projects to tailor the SETR implementation to fit the cost, schedule, and performance addressing program variables such as new software development methodologies and the Navy's capability delivery vision. This research includes

recommendations on how to increase likelihood of a program return on investment (ROI) for a tailored SETR implementation.

Leveraging a tailored SETR implementation provides the necessary structured engineering framework while keeping up with a dynamic software development environment to meet increasing need for enhanced capability delivered to the warfighter in a shorter timeframe. However, how can the SETR implementation be tailored to most efficiently leverage resources and minimize schedule impact while addressing the acquisition, technical, and policy/legal requirements within naval software acquisitions? To accomplish this research, an empirical research methodology was leveraged consisting of four phases. First, a literature review was performed primarily focused on SETR-related policy across the DOD, DON, and naval SYSCOMs. The next phase consisted of an electronic survey with program system matter experts (SME) who had key leadership roles within various sizes of programs. Next, data from the survey responses and key findings from the literature review were analyzed together to identify commonalities and differences as it relates to the research questions. Finally, research conclusions and recommendations for future tailored SETR implementations were addressed as well as any suggestions to extend this thesis research.

More than 80% of the survey respondents from across various DON organizations indicated tailoring was occurring within programs to address program specific needs such as aggressive schedule and leveraging an agile software development model. The tailored SETR events are directly impacting the program's next phase through adjustment of technical design and other key program variables. In a tailored SETR implementation, the programs find the most ROI by tailoring entrance criteria, exit criteria, and/or which specific reviews are included. This holds true for both commercial off-the-shelf and new development software acquisition models. Factors external to the organization continue to be the primary obstacle, no matter the program size, for determining the ability to successfully tailor and implement the SETR process. Future naval software acquisition programs should engage leadership, focus on

preparation, maintain early and often communication, and educate stakeholders to improve ROI of the tailored SETR implementation.

Reference

Department of Navy Space and Naval Warfare Systems Command. 2009. *Naval SYSCOM Systems Engineering Policy.* Space and Naval Warfare Systems Command Instruction 5000.1. San Diego, CA. March 17. https://wiki.spawar.navy.mil/confluence/download/attachments/4327001/SPAWARINST%205000.1%20NAVSYSCOM%20Eng.%20Policy%20-%20Joint%20Inst%20508%20Compliant.pdf?version=1&modificationDate=1386774156000&api=v2.

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ACKNOWLEDGMENTS

This thesis provided me the opportunity to interact with some of the most talented and enthusiastic individuals within the Navy. Thank you all for the guidance, support, and encouragement. The completion of this thesis would not have been possible without the support and continual guidance from Dr. Wally Owen, Dr. Rama Gehris, and Heather Hahn at the Naval Postgraduate School. I truly appreciate the help—no matter the question or hour—throughout this process. I would also like to thank Raymond Held from Space and Naval Warfare Systems Command as well as Jamie Howell and Greg Robinson, both from Marine Corps Systems Command. You each provided valuable SETR-related technical guidance, which helped me to mature the concepts within the thesis. Finally, and most importantly, I would like to thank Scott and Oliver Burke for their amazing love and patience throughout this process.

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I. INTRODUCTION

A. BACKGROUND

The systems engineering technical review (SETR) process should be an event driven process that consists of one or more programmatically independent review events with defined entrance and exit criteria (Department of Navy Space and Naval Warfare Systems Command [DON SPAWAR] 2009, 7). The SETR reviews assess the technical health, requirements accuracy, design maturity, testing effectiveness, and sustainment support of the program being reviewed over its life cycle. The jointly signed Systems Command (SYSCOM) policy states that program SETR events along with the event entrance and exit criteria are documented in the Systems Engineering Plan (SEP), which the SEP is signed by the program Milestone Decision Authority (MDA) or other designated authority based on the program Acquisition Category (ACAT) level. The SYSCOM policy notes that event closure normally occurs only after the exit criteria has been met, and the SETR technical review board (TRB) chair concurs with the identified action items along with any plan of action and milestones (POAM) and/or mitigations. According to the policy, the output of a SETR event ultimately informs the program manager (PM) whether the program is technically ready to move on to the next phase of the acquisition process.

The SETR process is intended to align with the phases of the acquisition process although the alignment varies depending on the acquisition model being executed. The models are detailed in the Department of Defense (DOD) *Operations of the Defense Acquisition System* (2015). From a software acquisition perspective, the DOD recognizes four models to which major ACAT programs align, which are software intensive, incrementally deploying software, accelerated acquisitions, or a hybrid acquisition with software being the dominate component (Department of Defense [DOD] 2015).

A traditional SETR process can include upwards of 12 types of reviews such as a system requirements review (SRR), preliminary design review (PDR), critical design review (CDR), and test readiness review (TRR). Various individuals are involved in these reviews to include program engineers, technical subject matter experts (SME), and other

independent stakeholders to ensure their areas are appropriately addressed within the program (DON SPAWAR 2009). For example, the stakeholders in a TRR event would include individuals from the developmental and/or operational testing agency. Figure 1 shows the timing of traditional SETR events in relation to the program acquisition phases.

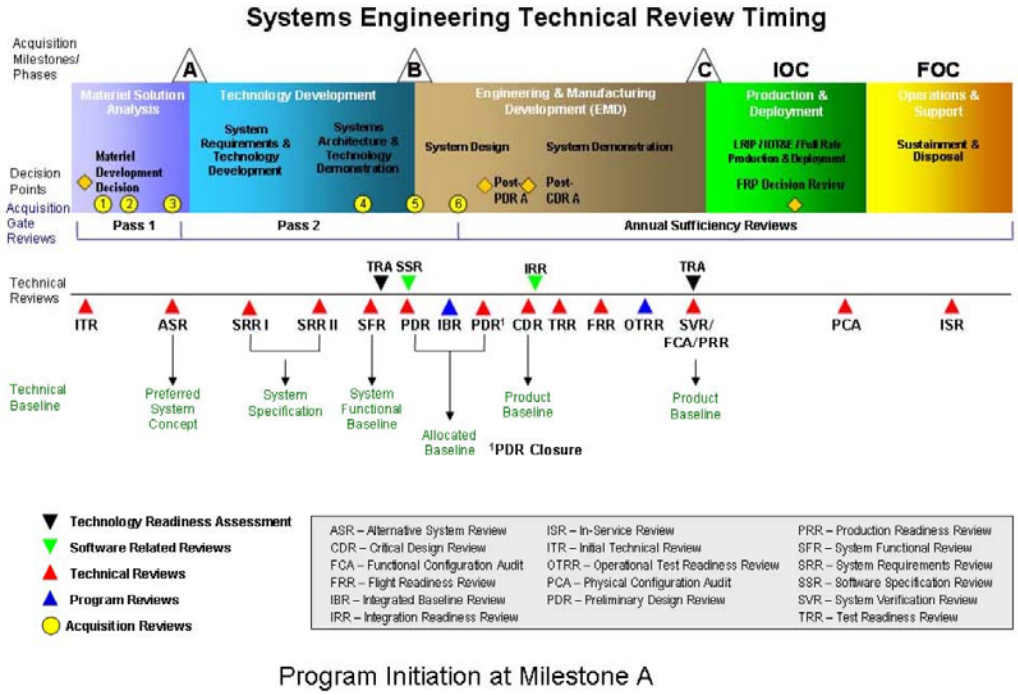

Figure 1. Traditional SETR Model. Source: DON SPAWAR (2009, Enclosure [1]).

B. PURPOSE

Leveraging a tailored SETR implementation provides the necessary structured engineering reviews while keeping pace with a dynamic software development environment to meet the increasing need for enhanced capability delivered to the warfighter in a shorter timeframe. In addition, the Navy has emphasized the need to deliver capability versus systems, and acquisition is impacted by this capability vision requiring innovative application of SETR for the system of systems (SoS) or platform level efforts, which tradition SETR is not well structured to support. This thesis provides an explanation of the traditional SETR process implementation within the various DON

SYSCOMs after the release of the memorandum from the Office of the Assistant Secretary of the Navy (Research, Development & Acquisition) (ASN[RDA]) in June 2008 directing this process implementation. Additionally, this thesis will provide an overview of how the SYSCOMs enable major acquisition programs and other projects to tailor their processes to fit the cost, schedule, and performance to address program impacts such as new software development methodologies and the Navy's capability delivery vision. This research includes recommendations on how to increase likelihood of a program's positive return on investment (ROI) for a tailored SETR implementation.

C. RESEARCH QUESTIONS

The primary research question for this thesis is: How can the SETR implementation be tailored to most efficiently leverage resources and minimize schedule impact while addressing the acquisition, technical, and statutory and regulatory requirements within naval software acquisitions? To answer this question, the following subsidiary questions will also be addressed.

1. What are the obstacles (e.g., policy, timelines, and maturity) and risks faced by naval programs that have attempted to tailor the SETR process? Do these obstacles vary based on the size of the program (e.g., ACAT I vs non program of record)?

2. What are the critical elements of the current system engineering technical review process (e.g., entrance/exit criteria, order of reviews, risk assessment) that program managers and/or lead engineers should include in a tailored implementation? What incentives or return on investment do these critical elements provide?

3. Are there any considerations/differences that should be accounted for when tailoring the process to support various acquisition models[(e.g., commercial off-the-shelf (COTS), new development, government off-the-shelf (GOTS)]?

4. What can engineers and program managers of future naval acquisitions learn from other programs that have attempted to tailor?

D. BENEFIT OF STUDY

This research includes recommendations based on lessons learned on how to increase likelihood of a program ROI for a tailored SETR implementation as it relates to

naval software acquisitions. The recommendations will assist program leadership in making better decisions on where to allocate software engineering resources within the schedule and funding constraints. While the thesis is focused on the DON, the recommendations are applicable to SETR implementations for software acquisitions programs across the broader DOD.

E. METHODOLOGY

To accomplish this research, an empirical research methodology was used in four phases. First, a literature review was performed focused on SETR-related policy, instructions, and memoranda across the DOD, DON, and naval SYSCOMs. The literature review also included other documentation (e.g., standards) from industry organizations such as Institute of Electrical and Electronics Engineers (IEEE). The next phase consisted of an electronic survey with program SME who had key leadership roles (e.g., program manager, lead engineer) within various sizes of programs (e.g., ACAT I, project). Table 4 includes the survey questions along with the potential responses. Next, data from the survey responses and key findings from the literature review were analyzed together to identify commonalities and differences as it relates to the research questions. Finally, research conclusions and recommendations specific to programs who wish to tailor SETR implementation were addressed as well as some suggestions to extend this thesis research.

F. THESIS ORGANIZATION

The chapters of the thesis are organized as follows: Chapter 1 is the introductory and background information. Chapter II is an overview of the SETR implementation which includes potential ways in which the process could be tailored, SETR success indicators, and applying SETR to support program risk mitigation. Chapter III is a review of the DOD, DON, naval SYSCOM policies, and industry standards relating to the SETR process. Chapter IV presents the data from the survey. Chapter V is the research analysis and discussion tying the policy review presented in Chapter III to the survey data with the goal of addressing the research questions. Chapter VI is the conclusions from the research and suggestions for follow on research.

II. SYSTEMS ENGINEERING TECHNICAL REVIEW IMPLEMENTATION

A. INTRODUCTION

ASN (RDA) directed in a 13 June 2008 memorandum that the SYSCOMs develop and implement the SETR process within their commands no later than 120 days from the date of memorandum to "ensure appropriate systems engineering aspects are included in the Gate Reviews" (1). The SETR process, which aligns to the acquisition phases, has since been documented in various SYSCOMs instructions and other supporting documentation as the implementation has matured. According to the jointly signed SYSCOM policy titled *Naval SYSCOM Systems Engineering Policy*, SETRs are "event-driven, have specific entry and closure criteria, and are used to evaluate technical baselines. The SETRs are chaired by technical authorities independent of the program, with participation by the PM and support from the associated Integrated Product Team (IPT) (government/contractor)" (DON SPAWAR 2009, 7). The SYSCOM policy states the SETR process assesses the program's technical health, requirements accuracy, design maturity, testing effectiveness, and sustainment support over the program life cycle. The SETR events that the program executes along with the event entrance and exit criteria are documented in the SEP, which is signed by the program MDA or other designated authority based on the program's ACAT level. Closure of the event normally occurs only after the exit criteria has been met; however, the SETR TRB chair can close an event with outstanding action items as long as the chair concurs with the identified action items along with any POAM and/or mitigations. According to the joint SYCOM policy, the output of a SETR event ultimately informs the PM if the program is technically ready to move on to the next phase of the acquisition process.

The Naval Sea Systems Command (NAVSEA) Research & Systems Engineering Warfare Systems Engineering and Human Systems Integration Directorate (05H) includes this comprehensive list of SETR objectives in the December 2009 *Technical Review Manual:*

Assessing the development maturity based on technology maturity and technical development goals from the SEP, SE events and accomplishments, and empirical test data supporting progress to date.

Ensuring operational, functional, performance, Information Assurance (IA) and cost requirements, designs, technical performance measurements, and technical plans are being tracked and are on schedule.

Assessing the system requirements to ensure that the requirements are unambiguous, consistent, complete, feasible, verifiable, ranked for priority and stability, and traceable to top-level requirements (TLRs).

Demonstrating that the relationships, interactions, interdependencies, and interfaces between required items and externally interfacing items, system functions, subsystems, and system elements (including usability and maintainability), as appropriate, have been addressed.

Ensuring open architecture (OA) in the emerging system; assessing the degree of Naval Enterprise reuse (availability and potential for component reuse); and critiquing any tradeoff decisions.

Ensuring that the results of trade studies are used to define concepts and that risks associated with alternatives have been analyzed.

Ensuring that technical designs will be usable by the target warfighter population, meet the Fleet requirements and have viable training options.

Ensuring that trade studies include IA and safety requirements and that the risks of failing to meet these requirements have been properly treated.

Confirming that the effects of technical risks on cost, schedule, and performance, as well as risk reduction measures, rationale, and assumptions made in quantifying the risks have been addressed.

Providing a forum for communication, coordination, and integration across all acquisition disciplines.

Establishing a common configuration baseline from which to proceed to the next level of design.

Confirming that continued development is warranted (with or without modifications to the program), and when it is not, identifying the technical measures necessary to preserve for reuse as much of the technology, hardware (HW), and software (SW) developed to date as possible. In the case where program redirection or restructuring is considered appropriate, the review should ensure that executable alternatives have been defined

(discontinue development, or take corrective action on the products and/or processes of the current phase before proceeding to the next phase).

Verifying the system is ready for the appropriate level and type of testing or that appropriate approvals for production and certification have been granted

Identifying resources (e.g., people, funding, support assets, test facilities, as appropriate) required for continued development, testing, or production.

Reaching technical concurrence with stakeholders.

Provide a check of proposed design configuration versus specification and contractual requirements.

Evaluate systems configuration at different stages in terms of requirements. (Department of Navy Naval Sea Systems Command [DON NAVSEA] 2009, 3–2–3-3)

To accomplish these objectives, various individuals are involved in the reviews to ensure their areas of expertise are appropriately addressed within the program. Key participant roles that are consistent across the SYSCOM implementations include: SETR chair(s), independent assessors, and integrated product team (IPT) participants. The responsibilities vary at the SYSCOM level for each of these key participant roles, but generally only to account for their organizational construct and do not represent a substantive variation.

The SETR TRB chair position can be held by one or more persons if there is significant interest in the program itself and/or perhaps a significant partner that has interest in the outcome of the system being delivered. Based on review of all SYSCOMs SETR policies, the minimum responsibilities of the chair(s) include:

- concurring on the entrance and exit criteria for the review
- facilitating collaborative participation throughout SETR process
- providing viable technical recommendation/guidance to address risks and issues identified in the process
- elevating any technical issues that cannot be resolved by SETR participants to SYSCOM Chief Engineer (CHENG)
- signing the SETR report (DON SPAWAR 2009, 9–12)

The SETR event independent assessors are either a Technical Authority (TA) related to the area being covered or, at a minimum, a designated representative of the SYSCOM TA. In some cases, the TA might also be asked to co-chair the SETR event. From a responsibility perspective, the independent assessors will focus their efforts on assessing risk in their area of expertise as well as providing viable technical recommendations/guidance to address these risks.

Beyond the SETR TRB chair and independent assessors, the IPT participants are key members of the SETR review team and make up the bulk of the membership especially from an execution of work perspective. These individuals review the artifacts associated with the SETR event to validate that the documents align to the higher level naval guidance requirements, do not conflict with one another, and address the intent of the review and the overall program (DON SPAWAR 2016c). The risk and issues are identified on the basis of the work from these members, which will ultimately turn into action items if not addressed prior to the closure of the SETR event as discussed in the SYSCOM policy. Figure 2 provides a SYSCOM level example of how the roles organizationally interact. Participants include a TRB, SETR support team (SST), and independent assessment team (IAT). The participants ultimately report back to the PM and CHENG.

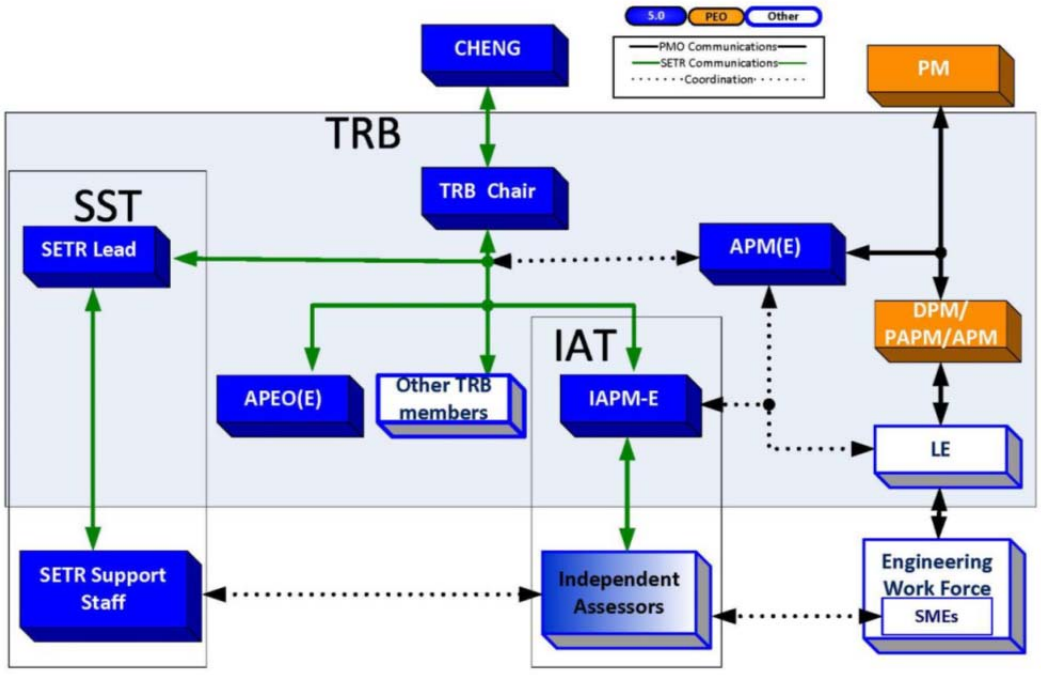

Figure 2. Example SYSCOM SETR Organization Chart.
Source: DON SPAWAR (2016c, 8).

The primary traditional SETR implementation events include the following:

- Critical Design Review (CDR)
- Functional Configuration Audit
- Integration Readiness Review
- Operational Test Readiness Review
- Physical Configuration Audit
- Preliminary Design Review (PDR)
- Production Readiness Review
- Software Specification Review
- System Functional Review
- System Requirements Review
- System Verification Review

- Test Readiness Review (Department of Navy Marine Corps Systems Command [DON MCSC] 2014).

Each event aligns to a different acquisition life cycle phase and determines the programs technical readiness to proceed into the next phase. Generally, entrance and exit criteria are fulfillment of a checklist of documentation and key program elements (e.g., verification of completeness of test procedures). The entrance criteria ensure the program is sufficiently technically mature to enter the event. SETR events are resource intensive, so premature entry will only frustrate all participants (at best). Similarly, the exit criteria ensure the program is technically ready to move to the next program phase. Examples of both entrance and exit criteria are shown in Table 1.

Table 1. Example SETR Entrance and Exit Criteria.
Source: DON SPAWAR (2016c, 48).

		Proposed Update (June 2016)		Reviewers											Additional		
Theme	Event	Entrance	Exit	Anti-Tmp	Arch	CM	HFE/HSI	IA/CS	I&I	MPT	R&M	Stan	SW	TE&C	I-APM-E	SST	Other TWH
	All	Technical artifacts, identified in the Technical Review Package (TRP, para 7.0 Table 7.1), are stable, updated, and available for independent review		x	x	x	x	x	x	x	x	x	x	x	x	x	x
Systems Engineering Plans	All	The latest approved TRA has been provided and a Maturation plan for any risks identified in the TRA.	The program has an acceptable level of maturity risk based on the current position on the acquisition lifecycle.				X		X	X	X		X	X	X		
Integrated Master Schedule	All	The latest approved SEP and additional stable, program representative draft documentation since approval have been provided.	Verification that SEP clearly articulates completed systems engineering activities and changes to projected systems engineering activities and is being followed. (Documentary evidence of IPTs, Working Groups, Milestones, Risk management, etc.)	x	x	x	x	x	x	x	x	x	x	x	x	x	

B. PROCESS TAILORING

Each SYSCOM has varying guidance regarding tailoring. Some SYSCOMs only lightly touch on the subject requiring that the tailoring is documented and agreed to within the program's SEP, while others provide more specific models and guidance. For example, SPAWAR's *Systems Engineering Technical Review Organizational Standard Process Handbook* provides specific tailored SETR models such as the Accelerated Acquisition Model. Similarly, but in the commercial sector, the IEEE Standard 15288, which is titled *Systems and software engineering—Systems life cycle processes,* has an appendix focused on process tailoring that is extremely applicable to many DOD acquisition programs. IEEE Standard 15288.2, which is titled *Technical Reviews and Audits on Defense Programs,* gets into SETR events and amplifies IEEE 15288. When determining if tailoring the SETR implementation is beneficial, it is important to be able to articulate the purpose, outcomes, and activities/tasks associated with the tailoring, which are the key points of IEEE Standard 15288 Annex A. With regards to the activities, the program should be able address the following items detailed in IEEE Standard 15288:

> Identify and record the circumstances that influence tailoring. These influences include, but are not limited to:
>
> > Stability of, and variety in, operational environments
> >
> > Risks, commercial or performance, to the concern of interested parties;
> >
> > Novelty, size and complexity;
> >
> > Starting date and duration of utilization;
> >
> > Integrity issues such as safety, security, privacy, usability, availability;
> >
> > Emerging technology opportunities;
> >
> > Profile of budget and organizational resources available;
> >
> > Availability of the services of enabling systems;

> Roles, responsibilities, accountabilities and authorities in the overall life cycle of the system;
>
> The need to conform to other standards.
>
> In the case of properties critical to the system, take due account of the life cycle structures recommended or mandated by standards relevant to the dimensions of the criticality.
>
> Obtain input from parties affected by the tailoring decisions. This includes, but may not be limited to:
>
> The system stakeholders;
>
> The interested parties to an agreement made by the organization;
>
> The contributing organizational functions.
>
> Make tailoring decisions in accordance with the Decision Management process to achieve the purpose and outcomes of the selected life cycle model.
>
> Select the life cycle process that require tailoring and delete selected outcomes, activities, or tasks. (IEEE Computer Society 2015, 86–87)

These activities are consistent with the principles within the SYSCOMs' guidance as well. For instance, SPAWAR's *Systems Engineering Technical Review Organizational Standard Process Handbook* defines tailoring as that which is "based on sound systems engineering practices, program or project complexity, and risk level, while meeting the objectives of the identified event" (2016c, 4). This definition ties closely to the IEEE Standard 15288 "identification and recording of the circumstances that influence the tailoring" as well as defining the purpose and outcome of tailoring the process itself (IEEE Computer Society 2015, 86). NAVSEA's O5H *Technical Review Manual* directs that tailoring be "consistent with good engineering judgment and program complexity and risk levels" (2009, 3–6). Naval Air Systems Command (NAVAIR) Instruction 4355.19E, which focuses on the *Systems Engineering Technical Review Process*, reinforces similar concepts to those of both SPAWAR and NAVSEA do; however, NAVAIR goes a step further to explain that "tailoring takes the form of deletion (removal of reviews and elements not applicable), alteration (modifying and combining reviews and elements to more explicitly reflect the application to a particular effort) or addition

(adding reviews and elements to satisfy program elements)" (2015, 6–7). Even with the additional context, this NAVAIR Instruction 4355.19E is still very consistent with the IEEE Standard 15288 process tailoring.

C. METRICS

The International Council on Systems Engineering (INCOSE) published a *Systems Engineering Leading Indicators Guide* on 29 January 2010, which defines a leading indicator as "a measure for evaluating the effectiveness of how a specific activity is applied on a project in a manner that provides information about impacts that are likely to affect the system performance objectives" (6). This is a critical definition at the heart of SETR events as the technical leadership of the program should be looking at any leading indicators (specific sets of metrics) across the program that would indicate impacts that would likely affect the systems performance or ability to meet the performance objectives laid out in the system requirements or other core documentation (e.g., Capability Development Document). Appendix A gives additional details regarding sample leading indictors based on IEEE Standard 15288.

Leading indicators generally are more focused on predictive analysis to support technical leadership decisions. However, it is important to not ignore conventional measures within the SETR event to ensure the technical report, which is an output of the SETR, provides a holistic look at the health and includes best recommendations to the PM. Table 2 includes some sample metrics that are included in SPAWAR's *Systems Engineering Technical Review Organizational Standard Process Handbook.* Several of the metrics are trending related around tracking risk and issues (R&I) (e.g., number of R&I by program) that would be measured over multiple SETR events. Using metrics such as those in the handbook provide a continuous process improvement aspect to the SETR event in order to minimize the potential of it being executed as a simple check in the box. In addition, the metrics enable a mechanism to assess maximum value from the program office perspective and/or a retrospective look back to improve in the next review event if the event did not provide value relative to the resources expended.

Table 2. Sample Metrics. Source: DON SPAWAR (2016c, 7).

Quantitative	Trends	Demand Signal
Number of SETR by Type, Maturity, and PMW	Number of R&I by PEO, PMW, Program	Workload forecast
Number of R&I by Closed, Open with Mitigation, Accepted Risk/Issue with No Further Action	By Assessment Area	Loading
Number of artifacts provided initially	Number of R&I by SETR Type	Planned events vs Actual events as documented in IMS, SEPs
Number of artifacts provided after initial upload to TRP	Number of R&I elevated to RFA	Specialized reviewers needed
Number of artifacts requested additionally during review period	Number of R&I closed during review	

Additionally, ASN(RDA)'s *Guidebook for Acquisition of Naval Software Intensive* Systems published in September 2008 highlights the SETR process as a risk management tool as it can be used to verify the following:

> Requirements for the acquired system are defined (including granularity to address software-specific requirements);
>
> Requirements are transformed into an effective system (including effective software components and subsystems);
>
> The processes are consistent and repeatable for the entire life cycle, where necessary;
>
> The provider/supplier uses a systematic approach in providing the required products and services;
>
> The test resources (personnel, facilities, test assets, test plans, ranges, etc.) are available and the product is ready for test;
>
> The product is ready for Operational Evaluation (OPEVAL) (validation environment, Operational Test & Evaluation Force (OPTEVFOR) personnel, ranges, etc.);

> Services/products are sustainable throughout the life cycle (including an adequate software support activity); and
>
> Systems are properly disposed of when they are retired from service. (Office of the Assistant Secretary of the Navy [Research, Development & Acquisition] 2008a, 6–10)

Each of these areas highlighted in the ASN(RDA) guide are key areas that the IPT participants or SMEs would be evaluating as they review various documents that are part of the entrance criteria, exit criteria, and/or other documents that are requested as part of requests for information (RFI) or requests for action (RFA) during the event itself. By tying the leading indicators, metrics and risk mitigations together a program can ensure the reviews provide measurable ROI to the program office as it moves forward in delivering new capability to the warfighter.

D. SUMMARY

ASN (RDA) Memorandum from 13 June 2008, which is titled *Systems Engineering Technical Review Process for Naval Acquisition Programs,* directed the SYSCOMs develop and implement the SETR process within their commands no later than 120 days from the date of memorandum. The SETR process, which aligns to the acquisition phases, has since been documented in various SYSCOMs instructions and other supporting documentation as the implementation has matured. The SETR process should be an event-driven process that consists of one or more independent review events to assess the program's technical health, requirements accuracy, design maturity, testing effectiveness, and sustainment support over the program life cycle (DON SPAWAR 2009, 7). The selection of SETR events to include any intended tailoring that the program executes is documented in the SEP. Per the jointly signed SYSCOM policy, the output of a SETR event ultimately informs the PM if the program is technically ready to move on to the next phase of the acquisition process. The following chapter provides a review of the DOD, DON, naval SYSCOM policies, and industry standards that give direction and guidance related to the process, entrance/exit criteria, leadership involvement, tailoring, and all other applicable aspects of the SETR process.

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III. POLICY AND STANDARD REVIEW

A. INTRODUCTION

This section provides a review of the DOD, DON, naval SYSCOM policies, and industry standards that give direction and guidance related to the process, entrance criteria, exit criteria, leadership involvement, tailoring, and all other applicable aspects of the SETR process. Each policy or standard will be summarized with an overview of how it relates to the SETR process, highlight any strengths of the document, and what if any possible unanticipated outcomes could be triggered by the policy or standard itself. Table 3 includes the list of items that will be reviewed as part of this section.

Table 3. Policy, Instructions, Memos Review List

DOD Policy, Instructions, & Memos
The Defense Acquisition System (DODD 5000.01)
Operations of the Defense Acquisition System (DODI 5000.02)
Business System Requirements and Acquisition (DODI 5000.75)
Deputy Assistant Secretary of Defense for Systems Engineering (DODI 5134.16)
DON Policy, Instructions, & Memos
ASN RD&A Memo, *SETR Process for Naval Acquisition Programs*, 13 June 08
Naval SYSCOM Systems Engineering Policy (SPAWARINST 5000.1)
DON Implementation and Operation of the Defense Acquisition System and the Joint Capabilities Integration and Development System (SECNAVINST 5000.2E)
SYSCOMs Policy, Instructions, & Memos
NAVSEA 05H *Technical Review Manual*, Version 2.0, 18 December 2009
NAVAIR *Systems Engineering Technical Review Process* (NAVAIRINST 4355.19E)
NAVAIR *Adapting Acquisition to Agile Software Development: A How-To Guide*, Version 2.0, 19 March 2014
MCSC *SETR Handbook* (SIAT-HDBK-001)
SPAWAR *Systems Engineering Policy* (SPAWARINST 5401.4)
SPAWAR *Systems Engineering Technical Review Policy* (SPAWARINST 5400.3A)
SPAWAR *Systems Engineering Technical Review Organizational Standard Process Handbook*
Industry Standards, Instructions, & Memos
IEEE *Technical Reviews and Audits for Defense*
SEI *Agile Software Teams: How They Engage with Systems Engineering on DOD Acquisition Programs*

B. DEPARTMENT OF DEFENSE

DOD Directive 5000.01, which is *The Defense Acquisition System* directive, establishes the basic policy governing how the DOD operates from an acquisition perspective to include responsibilities for key officials (e.g., the Assistant Secretary of Defense, Director of Operational Test and Evaluation), defining key terminology (e.g., program manager, milestone decision authority), and outlining policy around the Defense Acquisition System (e.g., flexibility, innovation) (DOD 2007). A key SETR-related element in this instruction is directing that the systems engineering approach should optimize "total system performance and minimize total ownership costs" (9). Fundamentally, the SETR process supports the key tenants of this systems engineering policy, so it is incumbent upon all involved in planning and executing the program SETR to ensure the reviews do not become a "check-the-box" event.

DOD Instruction 5000.02, which is the *Operation of the Defense Acquisition System* instruction, establishes the policy for how acquisition programs shall be managed. This is the first DOD policy from a policy hierarchy perspective where SETR reviews begin to appear. Based on the ACAT of the program, enclosure 3 of this instruction lays out the minimum technical reviews that program managers will conduct, which consist of a PDR and a CDR (DOD 2015). The instruction enclosure also includes at what level these reviews will be conducted. For example per the instruction, MDAPS can conduct system level PDR assessments at the MDA level while an ACAT IC must conduct the review at the Component Acquisition Executive (CAE) level.

DOD Instruction 5000.75, which is the *Business Systems Requirements and Acquisition* instruction, became effective on 2 February 2017 during this research effort. This instruction establishes the policy for how business systems will be managed (DOD 2017). This instruction supersedes DODI 5000.02 for "business system acquisition programs that are not designated as a Major Defense Acquisition Program according to DoDI 5000.02" (1). A business system as described by this instruction include "financial systems, financial data feeder systems, contracting systems, logistics systems, planning and budgeting systems, installations management systems, human resources management systems, and training and readiness systems" (31). The instruction does not include

SETR-specific language, but does require technical and management assessments to be addressed in the required implementation plan. The "assessment structure will reflect the program's tailored software development life cycle and may include events such as design reviews and test readiness reviews or short iteration retrospectives and acceptance reviews" (24). The SETR related policy and other documentation at the DON and naval SYSCOM level was written prior to this instruction, so expectation is that future iterations of these documents would address items such as SETR best practices and implications related to this instruction.

DOD Instruction 5134.16, which is the Deputy Assistant Secretary *of Defense for Systems Engineering (DASD(SE))* instruction, primarily establishes the roles and responsibilities of the DASD(SE) position. However, this instruction from a SETR perspective lays the foundation for the SEP including who needs a SEP and minimum items that should be covered (e.g., reliability growth, considerations for life cycle management and sustainability). This document is not overly prescriptive by outlining the minimum SETR items required in a SEP, which are expected across DOD from a consistency standpoint.

C. DEPARTMENT OF NAVY

ASN (RDA) Memorandum from 13 June 2008, which is titled *Systems Engineering Technical Review Process for Naval Acquisition Programs,* directed the naval SYSCOMs to develop and implement the SETR process within their commands no later than 120 days from the date of memorandum to "ensure appropriate systems engineering aspects are included in the Gate Reviews" (1). The 2008 ASN (RDA) memorandum also lays out other fundamental pieces of the process that will not change such as having including independent assessors, extended IPT members, and enabling tailoring based on program scope and complexity. From a naval prospective, this is a crucial piece of SETR documentation that lays the foundation, from which all the SYSCOMs' SETR frameworks are derived.

SPAWARINST 5000.1, which is the *Naval SYSCOM Systems Engineering Policy, SYSCOM Engineering and Technical Authority Policy,* is a jointly signed naval SYSCOM

policy that establishes systems engineering policy and a common SETR process across the DON (DON SPAWAR 2009). From a background perspective, the policy baselines roles, responsibilities, and definitions previously covered in other documents such as what the PM's role is, what systems engineering means, and what the acquisition life cycle is. The policy states the SEP must detail the SETR schedule, which will help in understanding the sequencing relative to other program events. Once the SEP is approved, this will also indicate approval of the SETR schedule. In the section specific to SETR policy, SPAWARINST 5000.1 highlights the following fundamental SETR elements:

- TRB Chair: must be designated in writing; generally a senior individual in the SYSCOM technical authority; holds the final authority for closing the review
- Agenda: includes TRB membership, SETR participants, schedule, and entrance/exit criteria
- Conduct: New issues should not arise at the SETR or this perhaps indicates that the SETR is being held prematurely
- Document Review: depends on objective analyses, correctness and completeness, which should be measured against clearly stated objectives
- Results: signed report by TRB chair closes out the event— must capture action items with appropriate status and include confidence level of baseline to move forward to next stage of development (10-12)

SPAWARINST 5000.1 stays at a high enough level of policy to not hinder the individual SYSCOMs as they define their SETR frameworks and guidance to the acquisition and technical workforce. This document also provides baseline consistency and a common vocabulary for how SETRs are implemented across the DON, which is critical as the Navy drives towards more SoS deliveries requiring more cross SYSCOM interaction and program to program interdependencies.

SECNAVINST 5000.2E, which is titled Department of the Navy Implementation and Operation of the Defense Acquisition System and the Joint Capabilities Integration and Development System, establishes the procedures for defense acquisition programs specifically related to the Joint Capabilities Integration and Development System (JCIDS) (Office of the Secretary of the Navy 2011). From a SETR perspective, the instruction

provides the basis for the concepts mentioned in the jointly signed SYSCOM policy SPAWARINST 5000.1, but it does reach a much broader audience being a SECNAVINST. Additionally, the instruction introduces a new "IT Box" concept that increases the value of the ability to tailor a SETR implementation. The "IT Box" approach, which is applied to software development programs, is "meant to lighten the burden of JCIDS as the program integrates systems enhancements described by the CDD [Capabilities Development Document], and allows programs to take full advantage of evolving commercial technologies" (1-11). In lieu of writing a Capabilities Production Document, the "IT Box" allows programs to write an annex to the CDD or an existing document to address four critical elements: "definition of threshold capability levels based upon today's technology, a defined process for oversight and approval of future evolution, a defined plan for delivering those capabilities, and a defined level of funding" (1-11). The tailoring aspect of SETR is critical for those programs, which are leveraging "IT Box," in order to not slow down the increased design to deployment schedule enabled by "IT Box."

D. SYSTEMS COMMANDS

NAVSEA 05H *Technical Review Manual* published in December 2009 describes the SETR implementation objectives and execution guidelines (e.g., scheduling, documentation). The appendices of the document go into detailed descriptions of entrance and exit criteria for each SETR event, different documentation, architectural views, and scheduling details. Overall, the document is the most comprehensive of the SYSCOMs' SETR-related documents with regards to execution of a traditional SETR. From a roles and responsibilities perspective, the NAVSEA SETR TRB chair, per the manual, consists of a minimum two co-chairs, which is a bit different than the other SYSCOMs. The co-chair consists of the PM and the independent TA, which can be joined by other co-chairs, if there is a significant partner that warrants the position as detailed in the manual. The responsibilities across the chairs are still consistent with what was previously described, just shared across all the chairs. The remainder of the SETR organization is also consistent with the previously described organization in the process overview. The NAVSEA 05H *Technical Review Manual* goes into great detail about initial planning for closing out the SETR event, which is depicted at a high level in

Figure 3 from the manual. These steps are repeated for each individual review (e.g., PDR, CDR) within the SETR implementation. The manual also includes opportunities and/or reminders throughout that the implementation should be tailored based on the scope and complexity of the program, but it does not give any models on how to do this as SPAWAR does, for example. This provides maximum level flexibility for program engineers with previous experience tailoring and/or motivation to seek out the opportunity. However, by not providing any best practices, models, and/or lessons learned, it allows programs to each independently make the same mistake, which could be costly in time, material, and/ funding to the DON.

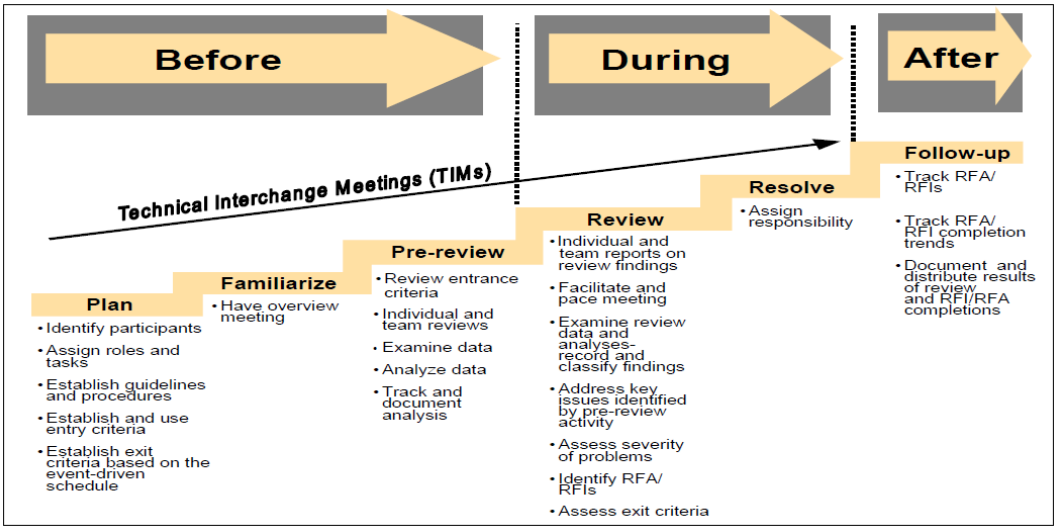

Figure 3. Sample SETR Execution.
Source: DON NAVSEA (2009, 3–15).

NAVAIRINST 4355.19E, which is titled *Systems Engineering Technical Review Process*, establishes the policy, guidance, and responsibilities with respect to the SETR implementation for the command (Department of Navy Naval Air Systems Command [DON NAVAIR] 2015). The instruction, which was published in February 2015, starts very early introducing a new SETR event called the Release Backlog Review (RBR), which NAVAIR introduced to deal with the agile software development methodology. Later in the instruction enclosure, NAVAIR includes entrance and exit criteria

expectations for incorporating this event into the SETR implementation. In addition, the NAVAIR instruction includes an entire section on SETR tailoring explaining that "tailoring takes the form of deletion (removal of reviews and elements not applicable), alteration (modifying and combining reviews and elements to more explicitly reflect the application to a particular effort) or addition (adding reviews and elements to satisfy program elements)" (6-7). Beyond this the NAVAIR instruction follows the general principles described in the SETR process overview, but the instruction takes a strong stance on encouraging tailoring when there is an "opportunity to optimize the program execution in the context of cost, schedule, and performance" (6).

NAVAIR's *Adapting Acquisition to Agile Software Development: A How-to Guide*, which was published in March 2014, documents some of the early concepts that were formalized in the NAVAIRINST 4355.19E. The guide gives more details in how to implement the RBR with some of the more typical SETR events such as PDR and CDR. RBR generally keeps a more consistent pace with what agile development refers to as development sprints, which require government SMEs to stay closely engaged. At some point after generally multiple RBR have been executed, a PDR will be held that will consist of the software architecture from these executed RBR and the "tentative allocated backlog will be established" (DON NAVAIR 2014, 7). RBR will continue to be held until the appropriate time for the CDR and likewise the TRR, which is shown in Figure 4. Generally, NAVAIR programs are either Major Defense Acquisition Programs or Major Automated Information Systems including both HW and SW, which require the PDR and CDR. Otherwise, the program could tailor the SETR implementation further.

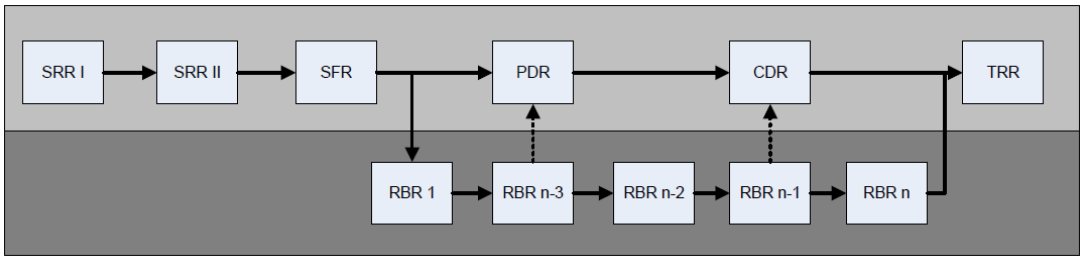

Figure 4. RBR within SETR Implementation.
Source: DON NAVAIR (2014, 7).

Marine Corps Systems Command (MCSC) SIAT-HDBK-001, which is titled *Systems Engineering Technical Review (SETR) Handbook*, provides guidance on planning and execution of SETR events. The handbook sets the tone in the early stages of the document with a concise graphic that shows tailoring opportunities as it aligns to the entrance into the acquisition life cycle and program risk, which is included in Figure 5 (DON MCSC 2014). It introduces a new event that the other SYSCOMs do not have, which is the non-developmental item (NDI) integration review (NIR). At a high level, the intent of the NIR, per the handbook, is to ensure that the system under review can meet the stated performance requirements and move to the next step in the acquisition life cycle within cost and schedule while integrating the COTS, GOTS, or other proposed NDI. This review is held instead of a PDR and CDR, but addresses the same technical rigor of these reviews. The MCSC SETR organizational structure as well as planning, execution, and close out processes are similar to those discussed in the SETR process overview. The MCSC *SETR Handbook* has a detailed appendix for each SETR event that includes an event overview, entrance criteria, review elements, agenda, exit criteria, and evaluation criteria. This resource acts as a job aid and future reference as the MCSC-related programs are executing events to help ensure consistency across the organization, which is a key document strength.

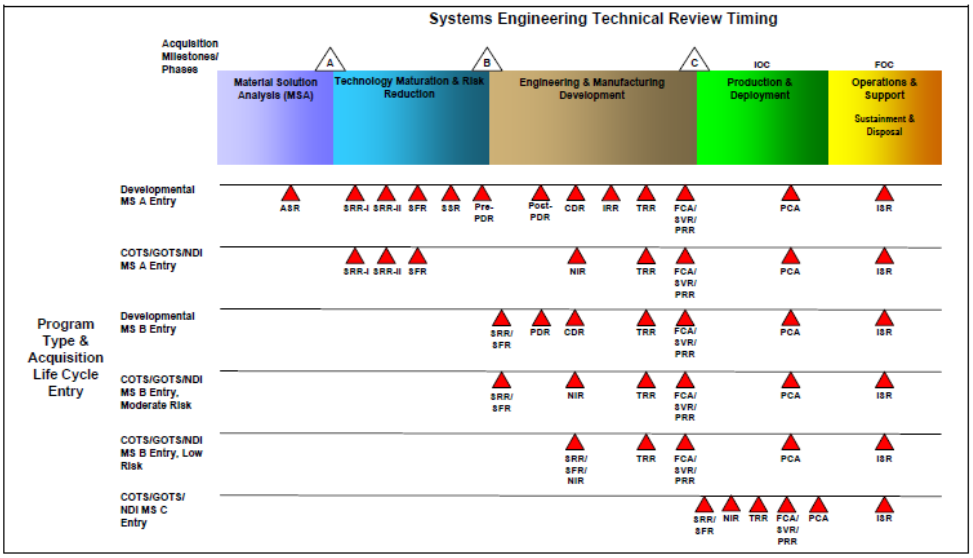

Figure 5. SETR Tailoring In Relation to Acquisition Life Cycle. Source: DON MCSC (2014, 3).

SPAWARINST 5401.4, which is titled *Systems Engineering Policy*, establishes the systems engineering policy for the command. Within this instruction, it directs that SPAWAR 5.0 will conduct SETRs to support "the delivery of an integrated, interoperable, and tested capability to the Fleet" (DON SPAWAR 2016b, 2). As stated in the SETR overview, this will be documented by programs in the SEP; but in addition SPAWAR mandates that it must be completed and submitted to SPAWAR 5.0 within three months of program initiation. From a SPAWAR perspective, this is the first instruction that includes guidance on the SETR implementation.

SPAWARINST 5400.3A, which is titled *Systems Engineering Technical Review Policy*, establishes the policy and responsibilities associated with the SETR implementation for SPAWAR. Key roles are held by the SPAWAR CHENG and the respective PM when conducting the SETR. The associated enclosure, which is the *Systems Engineering Technical Review Organization Standard Process Handbook*, provides the core of the implementation guidelines to the SYSCOM.

SPAWAR's *Systems Engineering Technical Review Organization Standard Process Handbook* goes into the most detailed tailoring options of all the SYSCOM

documentation. The handbook provides a SETR implementation for each of the following models that can be implemented within the SYSCOM:

- Model 1: Hardware Intensive Program (traditional SETR)
- Model 2: Defense Unique Software Intensive Program
- Model 3: Incrementally Fielded Software Intensive Program
- Model 4: Accelerated Acquisition Program

Model 1 aligns to what was discussed in the SETR overview. However, Figure 6 shows an image to keep context as each of the additional models are reviewed.

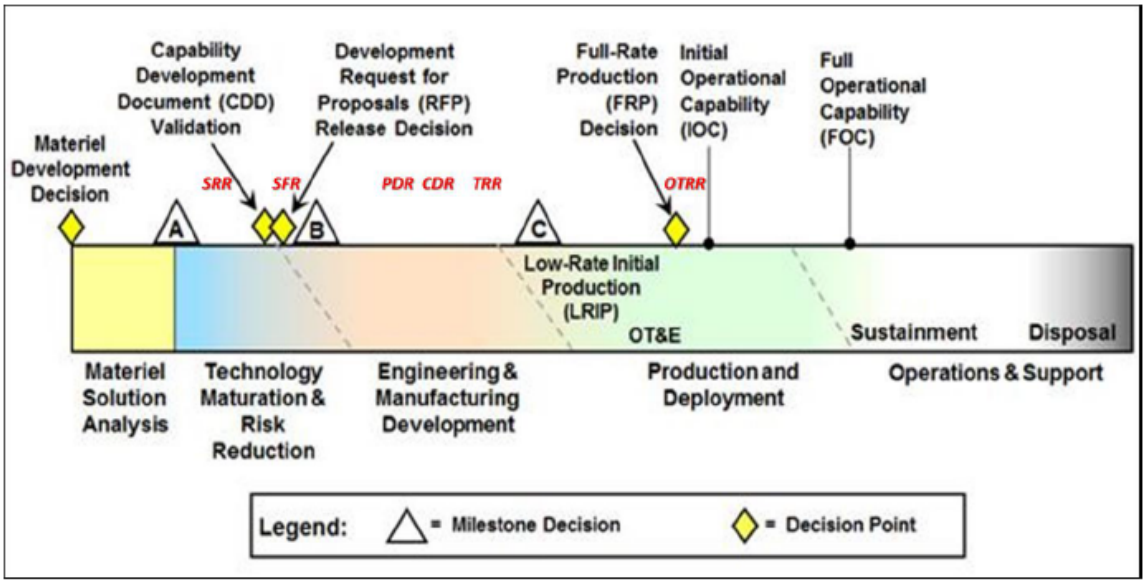

Figure 6. Model 1 Hardware Intensive Program. Source: DON SPAWAR (2016c, 18).

Model 2 comes into play when there is a defense unique software intensive program. The hardware has to be capable of being separated from the software builds to allow more tailored approach on the SETR side for software. However, the combined software and hardware builds are deployed on a consistent combined schedule. This approach would be used when several software builds are necessary for a hardware build that is being deployed. This is the first introduction for SPAWAR of the Build Technical Review (BTR) and Fielding Technical Review (FTR) events, which again would be used for the

software while the hardware follows a more typical SETR implementation (DON SPAWAR 2016c). These two new reviews are designed to "assess systems engineering rigor for requirements decomposition, design, development, and testing to allow greater flexibility and response to evolving technologies" per the handbook (22). In this case, the BTR would be supporting the incremental build and the FTR would be supporting the software side of the combined hardware/software fielding decision that a program would have for a traditional SETR event. Figure 7 shows this in an image to get a better idea of how the risk reduction occurs from a software perspective with the multiple BTR events during a normal timeframe to gain a better understanding of the technical maturity of the defense software and readiness to move to the next stage of the program's life cycle.

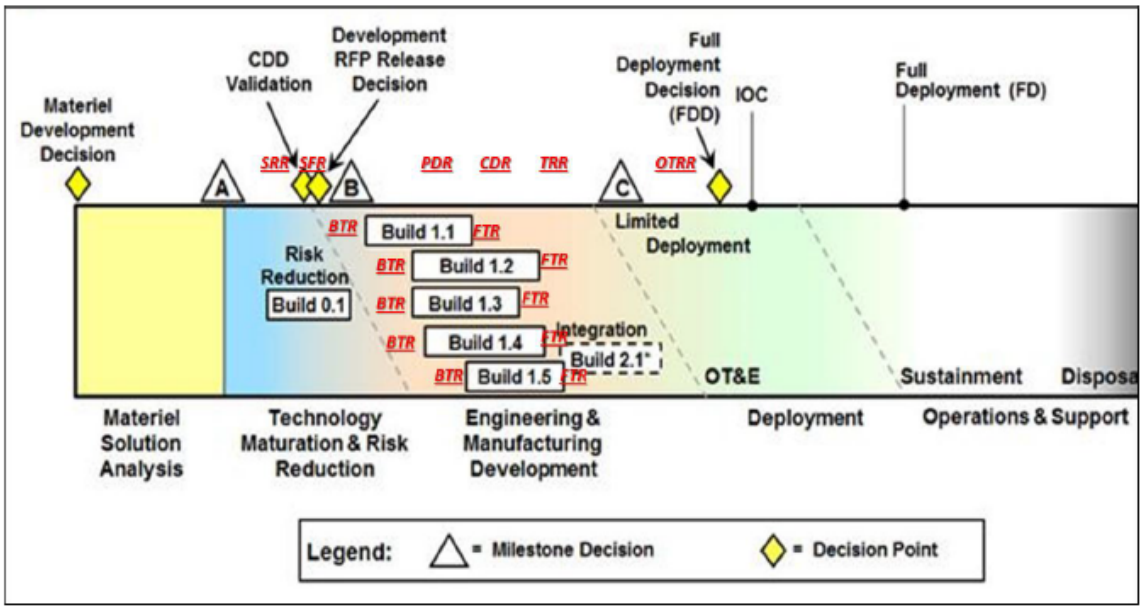

Figure 7. Model 2 Defense Unique Software Intensive Program.
Source: DON SPAWAR (2016c, 19).

The next model in the SPAWAR *Systems Engineering Technical Review Organization Standard Process Handbook* takes the biggest departure from the traditional SETR implementation with incrementally fielded software intensive program model. Model 3 also makes use of the BTR and FTR concepts. Due to the more pure software nature of the program coupled with the new SETR events instead of the traditional SETR events,

the program can make more rapid software deployments to the warfighter as shown in Figure 8 by the incremental builds depicted in each SETR "row." The SW would be built agnostic to the specific HW, but compliant with HW standards.

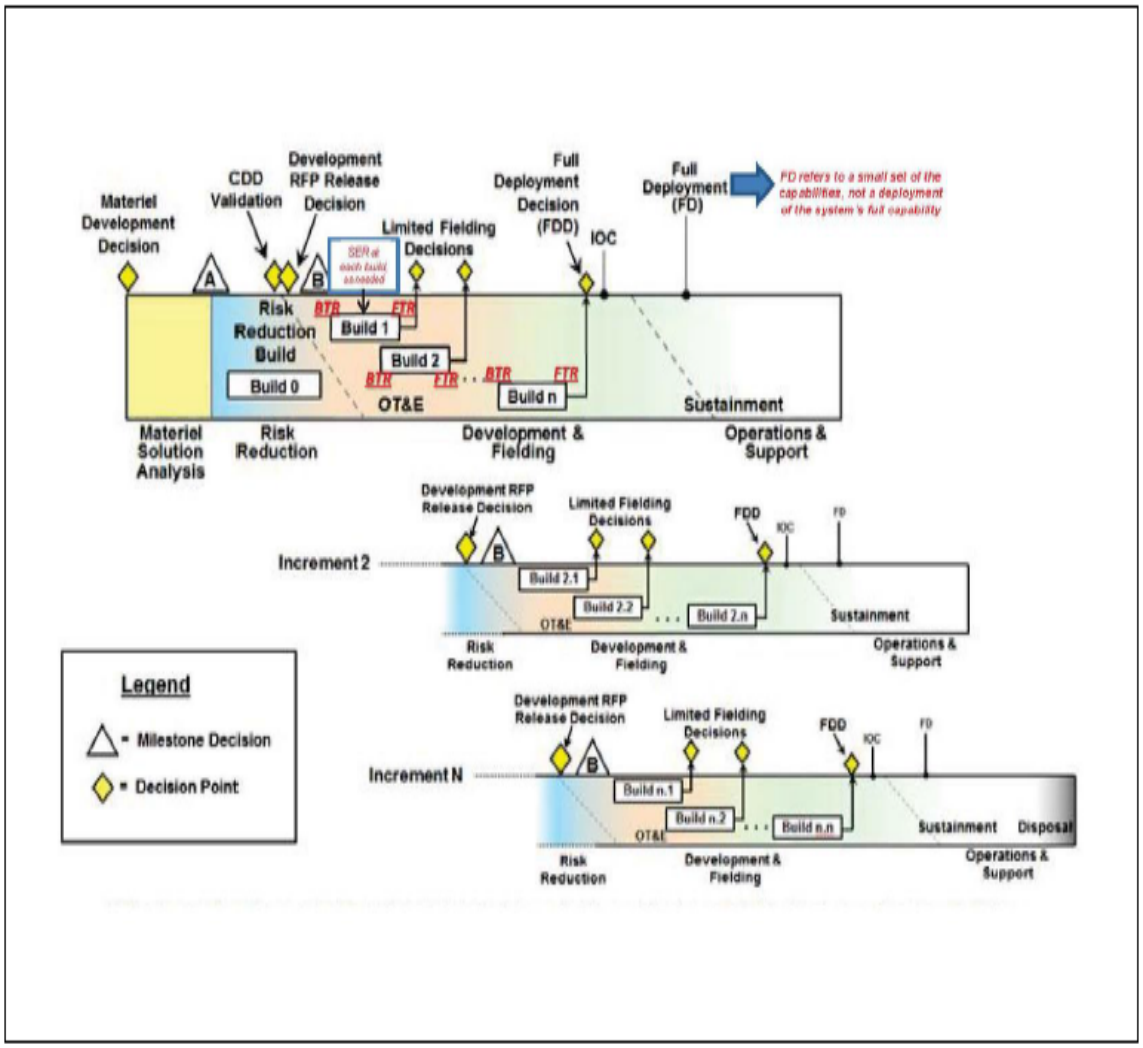

Figure 8. Model 3 Incrementally Fielded Software Intensive Program.
Source: DON SPAWAR (2016c, 23).

The final model shown in Figure 9 and provided by the SPAWAR *Systems Engineering Technical Review Organization Standard Process Handbook* is the most rapid SETR model depicted. The handbook points out that this model should be used when "schedule dominates over cost and technical risk considerations" and should be used when

"technological surprises by a potential adversary necessitates a higher-risk acquisition program" (24). So even though it is the most rapid, it is rather specific in terms of when it should be leveraged. This model introduces an additional event in the handbook called the SETR-Lite Engineering Review (SER), which, as it sounds, is a highly tailored and focused review to support a specific program decision; but still contains the rigor of other SETR events. In an accelerated acquisition program as depicted in Figure 9, a SER is executed at a minimum twice. However, the SER is a useful review for projects that may not meet the threshold for a traditional or even tailored SETR implementation, so a SER can be executed to meet the intent of an independent technical review as often as needed in the project life cycle.

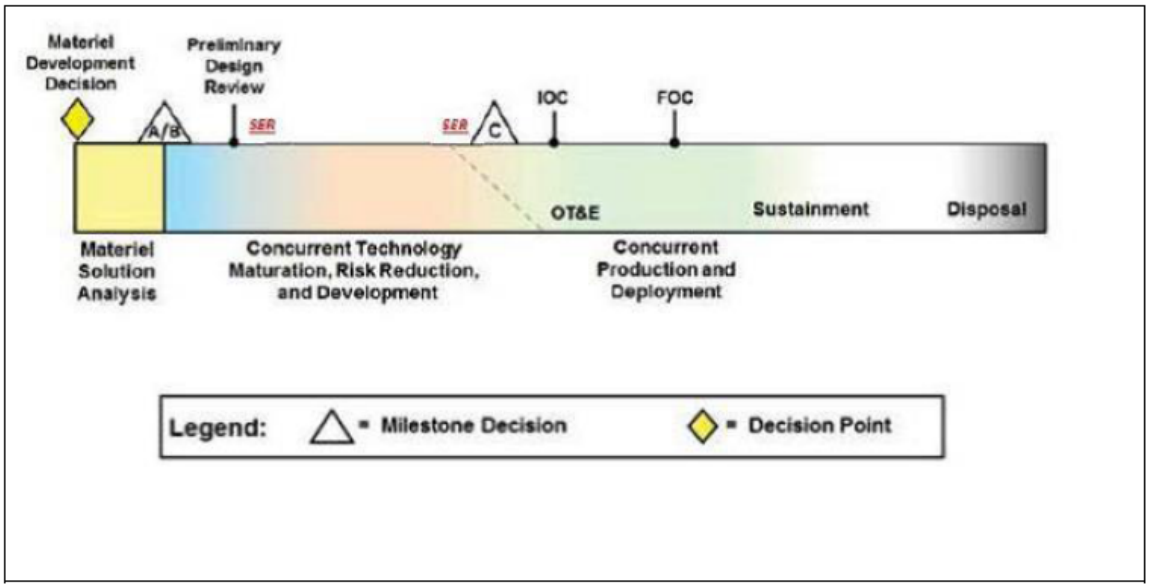

Figure 9. Model 4 Accelerated Acquisition Program.
Source: DON SPAWAR (2016c, 25).

E. INDUSTRY

IEEE Standard 15288.2-2014, which is the *Standard for Technical Reviews and Audits on Defense Programs*, details the traditional SETR implementation; however, much like described in the process tailoring section for IEEE Standard 15288, there is a section up front in the document that speaks to process tailoring and expectations. Unlike

the DOD or DON documentation, the IEEE Standard 15288.2-2014 includes a solid baseline definition list, which includes items such as the following:

> **acceptability criteria:** A documented set of characteristics of a program's work products that if satisfied, forms a sufficient basis for judging each product's content to be acceptable to support a successful review or audit.
>
> **entry criteria:** Artifacts and other review or audit elements that must be completed before the review or audit can be conducted.
>
> **exit criteria:** Review or audit elements that must be assessed, completed, and action items closed before successful completion of the technical review or audit can be declared.
>
> **technical reviews:** A series of systems engineering activities conducted at logical transition points in a system life cycle, by which the progress of a program is assessed relative to its technical requirements using a mutually agreed-upon set of criteria. (IEEE Computer Society 2014, 4–5)

The IEEE Standard 15288.2-2014 goes through each traditional SETR event to explain what makes up a successful event. Starting off, each section explains the acceptability criteria for the event with regards to each product (e.g., system specification) that will be reviewed at the event. The standard moves on to detail what is required for event preparation broken down by the responsible person and their associated actions. The actual execution of the event is then explained along with what will be reviewed in each part of the SETR event itself. Finally, this section of the standard speaks to what is needed to successfully close out this SETR event from each person and for what actions are they responsible. While the NAVSEA 05H *Technical Review Manual* contained great detail about planning to closure of a SETR event, this IEEE Standard 15288.2-2014 goes step by step for each traditional SETR event including what it takes from planning all the way to closure of each individual event, which is similar to the level of detail in the MCSC *SETR Handbook*.

The Software Engineering Institute (SEI) released a technical note on *Agile Methods: Selected DOD Management and Acquisition Concerns* in October 2011, which frames the use of agile as a mechanism to address the "disconnect between the warfighter/demand tempo and the acquisition/contracting tempo" (Software Engineering Institute [SEI] 2011, 3). The technical note addresses topics such as contract execution,

contract monitoring, and sustainment when a program is leveraging agile development methodology. Of note from a SETR perspective, the technical note describes two potential solutions for dealing with more traditional technical reviews to include specific advantages and disadvantages of each. The first option is translation of agile products into the traditional review events. Whether this translation is done by the vendor themselves or another support entity (e.g., Systems Engineering and Technical Assistance contractor), the program, as pointed out by the SEI technical note, is incurring a cost to translate the agile material into traditional documents, which may outweigh the benefit agile provides. The second option the SEI technical note provides is to execute more iterative reviews, or mini events, that build up to a more traditional SETR event. This second option is similar to the tailored NAVAIR's RBR or SPAWAR's BTR.

F. SUMMARY

The DOD and DON directives and instructions lay the system engineering foundation for the naval SYSCOMs guidance regarding SETR implementation. The following are the key attributes from each of the higher level DOD and DON documents reviewed in this chapter:

- *The Defense Acquisition System* (DODD 5000.01): Lays the foundation with a standard definition of what systems engineering is within the DOD.
- *Operations of the Defense Acquisition System* (DODI 5000.02): Includes requirement for PDR and CDR within DOD level instruction along with criteria for when applicable.
- *Business Systems Requirements and Acquisition* (DODI 5000.75): Supersedes DODI 5000.02 for defense business systems; includes reference to technical assessments that must be addressed in the implementation plan.
- *Deputy Assistant Secretary of Defense for Systems Engineering* (DODI 5134.16): Initial SEP requirement introduced at DOD level.
- ASN RD&A Memo, *SETR Process for Naval Acquisition Programs*, 13 June 08: Directs SETR implementation across naval SYSCOMs.
- *Naval SYSCOM Systems Engineering Policy* (SPAWARINST 5000.1): Specifies the minimum SETR elements (e.g., SETR chair, agenda, schedule, expected results) across the naval SYSCOMs.

- *DON Implementation and Operation of the Defense Acquisition System and the Joint Capabilities Integration and Development System* (SECNAVINST 5000.2E): Introduction of "IT Box" concept. Underscores the importance of being able to tailor the program's SETR implementation to keep pace with the increased design to deployment timeline that "IT Box" enables.

Each SYSCOM has varying guidance regarding SETR to include tailoring. The following are the key attributes from each of the SYSCOM documents reviewed in this chapter:

- NAVSEA 05H *Technical Review Manual*, Version 2.0, 18 December 2009: Provides most comprehensive traditional SETR guidance, but does have reminders for tailoring mentioned throughout. Appendix includes detailed descriptions of entrance and exit criteria for each SETR event, different documentation, architectural views, and scheduling details.

- NAVAIR *Systems Engineering Technical Review Process* (NAVAIRINST 4355.19E): Includes specific definition for tailoring SETR implementation. Introduces a tailored event—RBR—for agile software development.

- NAVAIR *Adapting Acquisition to Agile Software Development: A How-To Guide*, Version 2.0, 19 March 2014: Provides execution level details on the RBR.

- MCSC *SETR Handbook* (SIAT-HDBK-001): Encourages tailoring opportunities and even introduces the NIR, which is a tailored event. Detailed appendix for each SETR event that includes an event overview, entrance criteria, review elements, agenda, exit criteria, and evaluation criteria

- SPAWAR *Systems Engineering Policy* (SPAWARINST 5401.4): Mandates SEP, which is where SETR implementation is documented, must be completed and submitted to SPAWAR 5.0 within three months of program initiation.

- SPAWAR *Systems Engineering Technical Review Policy* (SPAWARINST 5400.3A): Establishes key SETR roles within SPAWAR.

- SPAWAR *Systems Engineering Technical Review Organizational Standard Process Handbook*: Provides a tailored SETR implementation for each DOD software acquisition models, which is the most extensive tailoring guidance in all of the SYSCOM documents.

The following list includes key attributes from the industry documents reviewed in this chapter:

- IEEE *Technical Reviews and Audits for Defense* standard: provides solid definitions (e.g., exit criteria, entrance criteria). With each event, the standard provides preparation instruction and other information to ensure the event is successful.

- SEI *Agile Methods: Selected DOD Management and Acquisition Concerns*: addresses topics such as contract execution, contract monitoring, and sustainment when a program is leveraging agile development methodology. Describes two potential solutions for dealing with more traditional technical reviews

The following chapter presents details on the method for collecting the data as well as presentation of the data gathered from the survey.

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IV. PRESENTATION OF SURVEY DATA

A. INTRODUCTION

To address the research questions, a survey was leveraged to gather data points from SMEs executing SETRs to understand how SETRs are being tailored, what impacts the SETR has on future acquisition steps, and what hurdles programs are currently facing. These survey responses are in the context of the current policies, instructions, and other job aides that are in place across the DOD, DON, and naval SYSCOMs. Upon conclusion of the analysis, recommendations will be provided based on lessons learned on how to increase likelihood of a program ROI for a tailored SETR implementation as it relates to naval software acquisitions. This chapter will provide details on the method for collecting the data as well as presentation of the survey data gathered. Appendix B provides the comprehensive survey data set. Chapter V provides the research analysis and discussion tying the policy review chapter to the data from the survey to address the research questions.

As suggested in Fowler's *Survey Research Methods,* one of the first steps in initiating a survey is choosing the appropriate sample frame to understand those who will be selected to participate in the survey as the target population (Fowler 2014). For this specific research, the survey was distributed across the engineering workforce at SPAWAR Systems Center Atlantic (SSC LANT) as well as shared with the other naval SYSCOMs where feasible. The target audience within these organizations was SMEs who have expertise organizing, leading, and/or participating in a program SETR event. SSC LANT engineering technical workforce is made up of about 3,000 government employees (Figure 10). The survey was focused within this engineering technical workforce to a more granular audience of SETR SMEs. SSC LANT supports other DON customers (Figure 11) as a working capital funded organization, which provided a unique opportunity to gain insight into other DON program SETR implementations through this survey population. The top five sponsors include four of the naval SYSCOMs—SPAWAR, MCSC, NAVSEA, and NAVAIR. As the SSC LANT technical workforce supports programs across these other SYSCOMs, the survey generated results that

provided insight across DON programs more completely than a survey of a single SYSCOM.

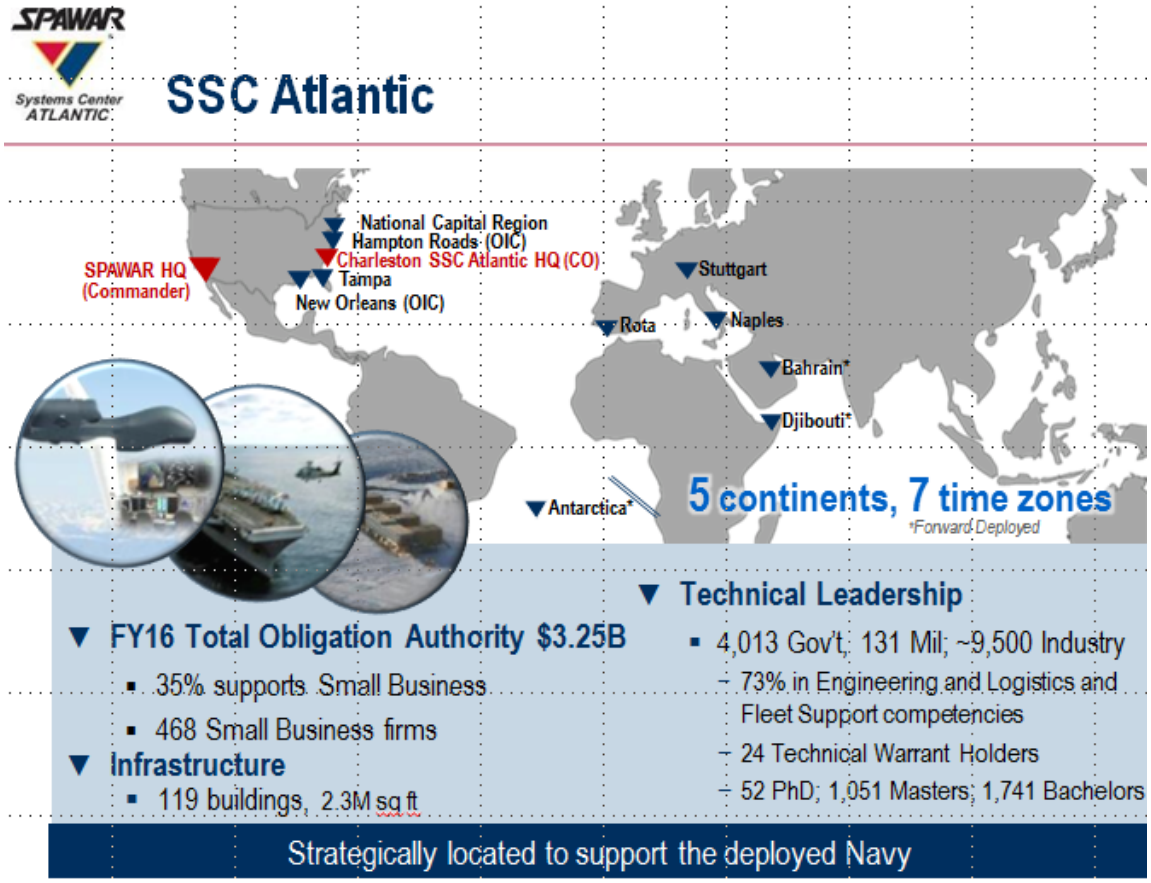

Figure 10. Command Technical Population. Source: Department of Navy (DON) Space and Naval Warfare Systems Command Systems Center Atlantic (SSC LANT) (2017).

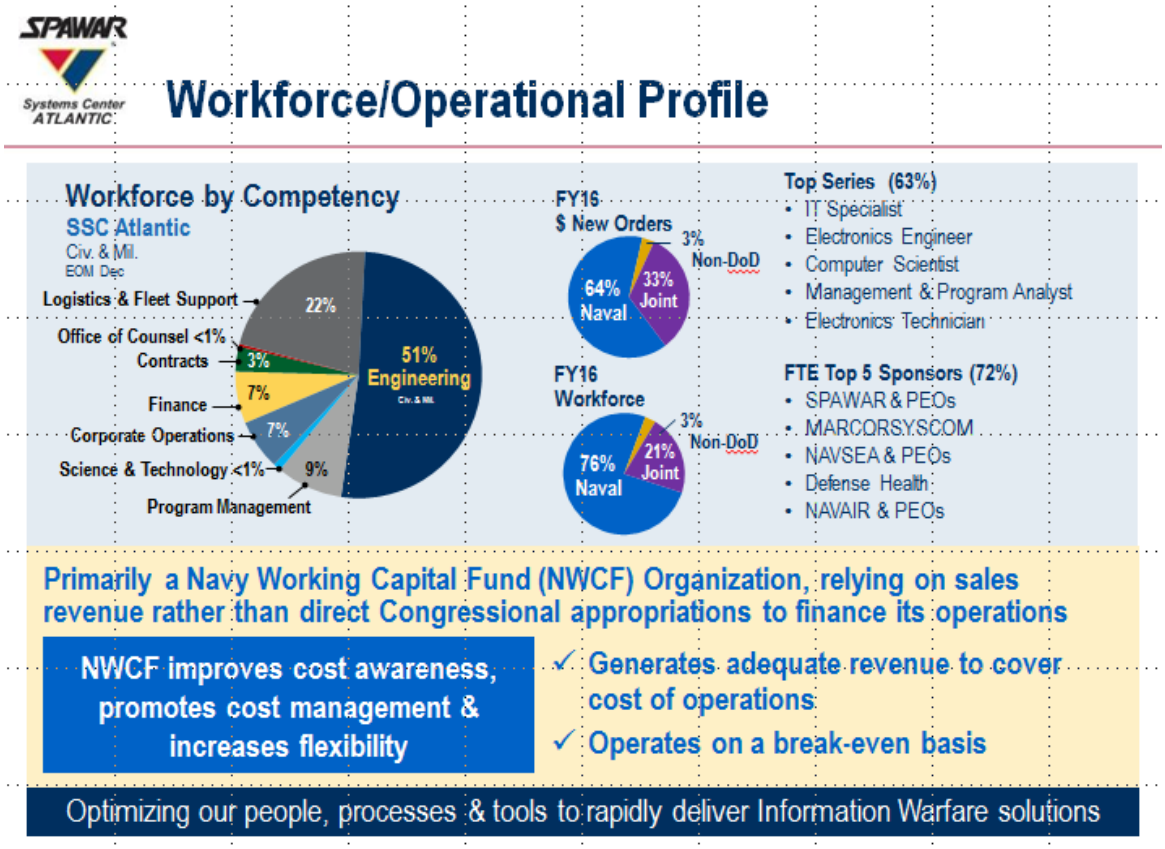

Figure 11. Command Workforce Profile. Source: DON SSC LANT (2017).

The online SurveyMonkey tool was used to distribute and collect the data from 26 April through 17 May 2017. Overall, the survey had 48 respondents. The survey did not require a user to provide identifying information, other than what organization they most closely associated with in order to understand the breadth of organizations that were sampled in the survey. The Naval Postgraduate School Institutional Review Board determined that the research is not designed to collect information about individuals and therefore is not human subject research. The survey questions, which are provided in Table 4, did collect a mix of objective and subjective data points. The objective data points consisted of those that are factually based, such as size of program, events tailored, and area of program adjusted (Fowler 2014). The subjective data points relate to a SMEs experience such as what events were most valuable. These questions were worded to reduce error such as personalizing the response by ensuring that the program was the acting noun not the person.

Table 4. Survey Questions and Potential Responses

No.	Survey Questions	Question Type	Response Options
1	Which organization are you most closely associated with?	Multiple Choice (Single Answer)	Department of Defense Department of Navy Marine Corps Systems Command Naval Air Systems Command Naval Facilities Engineering Command Naval Sea Systems Command Naval Supply Systems Command Space and Naval Warfare Systems Command Other
2	What is the size of the program that used the SETR process?	Multiple Choice (Single Answer)	ACAT I ACAT II ACAT III Other (please specify)
3	What type of software acquisition model did this program leverage?	Multiple Choice (Single Answer)	Commercial off-the-shelf Government off-the-shelf New Development Other (please specify)
4	Did the program tailor the system engineering technical review process to support your program?	Multiple Choice (Single Answer)	Yes No
5	If applicable, which part did you tailor?	Multiple Choice (Multiple Answer)	Review Order Reviews Included Entrance/Exit Criteria Not Applicable Other (please specify)
6	What reviews did the program include in the SETR process?	Multiple Choice (Multiple Answer)	Build Technical Review Capability Build Review—Initial Capability Build Review—Design Capability Build Review—Readiness Critical Design Review Fielding Technical Review Functional Configuration Audit Integration Readiness Review Operational Test Readiness Review Physical Configuration Audit Preliminary Design Review Production Readiness Review Release Backlog Review SETR-Lite Engineering Review Software Specification Review System Functional Review System Requirements Review System Verification Review Test Readiness Review Other (please specify)

No.	Survey Questions	Question Type	Response Options
7	Which review events did the program find most valuable to assessing the technical maturity of the program?	Multiple Choice (Multiple Answer)	Build Technical Review Capability Build Review—Initial Capability Build Review—Design Capability Build Review—Readiness Critical Design Review Fielding Technical Review Functional Configuration Audit Integration Readiness Review Operational Test Readiness Review Physical Configuration Audit Preliminary Design Review Production Readiness Review Release Backlog Review SETR-Lite Engineering Review Software Specification Review System Functional Review System Requirements Review System Verification Review Test Readiness Review Other (please specify)
8	What area of the program was adjusted based on the outcome of the SETR?	Multiple Choice (Multiple Answer)	Cost Schedule Technical Design No change Other (please specify)
9	By what percentage of the cost, schedule, and/or technical design was the program adjusted, if applicable?	Multiple Choice (Single Answer)	0-20% 21-40% 41-60% 61-80% 81-100% Not Applicable
10	Did any of the following options limit or create obstacles if the program tailored the SETR implementation?	Multiple Choice (Multiple Answer)	Internal Organization External Organization Policy No limitation Not applicable Other (please specify)
11	Did the program include any metrics to assess the return on investment from the reviews?	Multiple Choice (Single Answer)	Yes (please specify), No
12	Did the program have consistent leadership throughout a complete SETR cycle?	Multiple Choice (Single Answer)	Yes, No
13	Please provide any additional feedback regarding SETR implementations.	Free Text	N/A

B. SURVEY DATA

(1) Question 1

Figure 12 provides the results to the initial question—"Which organization are you most closely associated with?" The intent of this question was to understand from a sampling perspective which organizations were covered or not during the survey period. SPAWAR was the SYSCOM that the majority of participants most closely associated themselves with, followed by the DON.

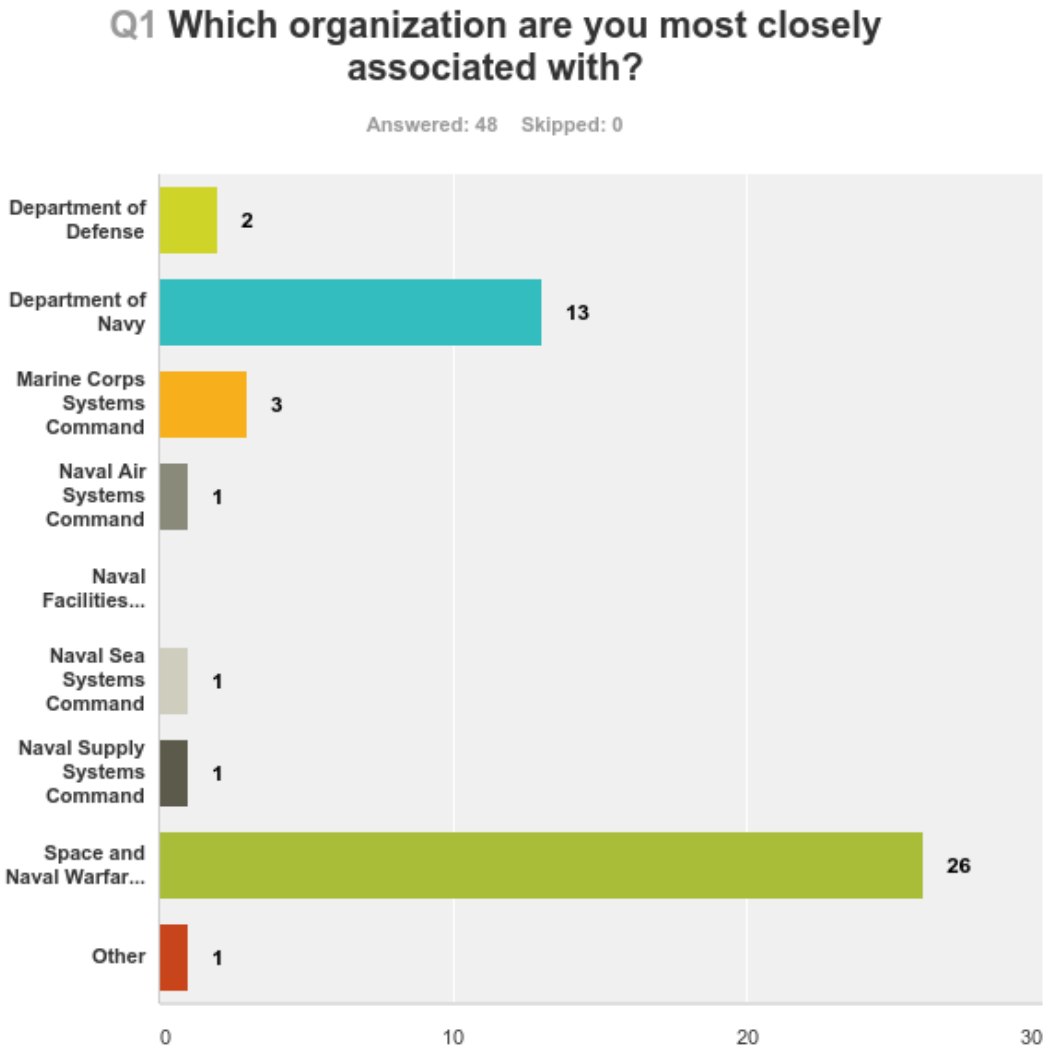

Figure 12. Question 1 Survey Results

(2) Question 2

Figure 13 provides the results to the second question—"What is the size of the program that used the SETR process?" This question was included to understand, from a sampling perspective what mixture of ACAT program types was covered in the survey. Most survey participants were involved in ACAT I programs. Seven of the nineteen responses in the "other" category specified that the program size was an abbreviated acquisition program (AAP). Per SECNAVINST 5000.2E, AAP are programs at a high level that do not require operational test and evaluation as documented by the Operational Testing Agency (OTA) and meet a specific dollar threshold per the instruction. The complete set of responses provided in the free text field—"Other (please specify)"—are included in Appendix B.

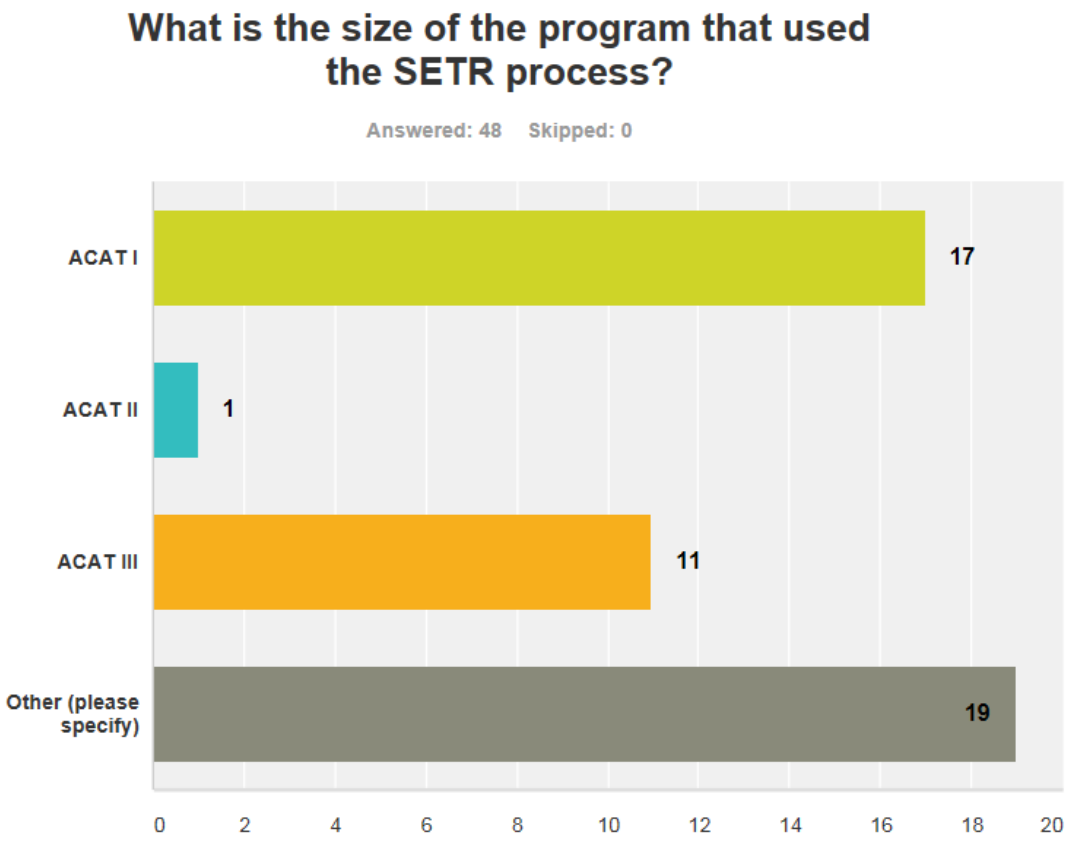

Figure 13. Question 2 Survey Results

(3) Question 3

Figure 14 provides the results to the next question—”What type of software acquisition model did this program leverage?” This question was incorporated into the survey to help answer the research question regarding if there were any specific tailoring concerns based on the type of acquisition model the program leveraged. Most of the participants acquired COTS based on the responses provided. Ten of the thirteen “other” responses included some combination of the original response options provided (e.g., COTS and GOTS, all). The complete set of responses provided in the free text field—”Other (please specify)”—are included in Appendix B.

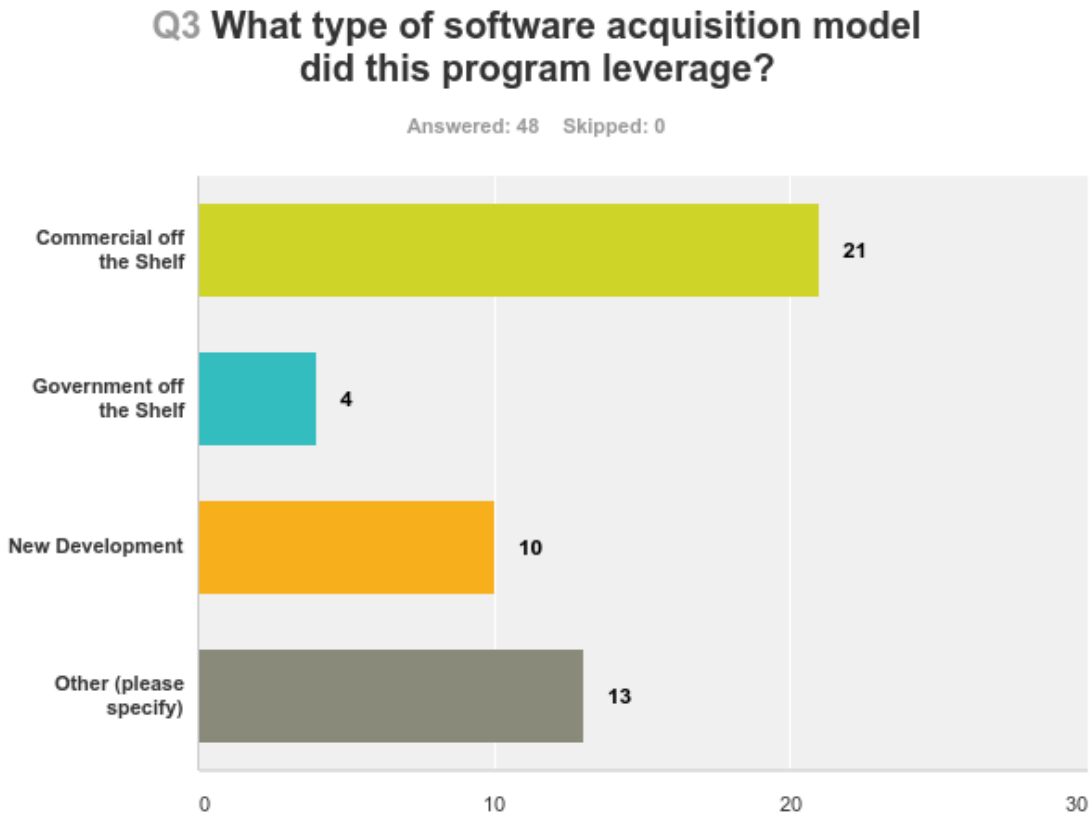

Figure 14. Question 3 Survey Results

(4) Question 4

Figure 15 provides the results to the fourth question—"Did the program tailor the SETR process to support your program?" This question begins to get at the heart of the thesis regarding whether programs are leveraging the tailoring allowed by the current policies in places across the DOD, DON, and their respective SYSCOMs. Based on the participant's responses, programs do appear to be taking advantage of the various tailoring opportunities described in the current policies as over 80% responded yes the program did tailor the SETR implementation.

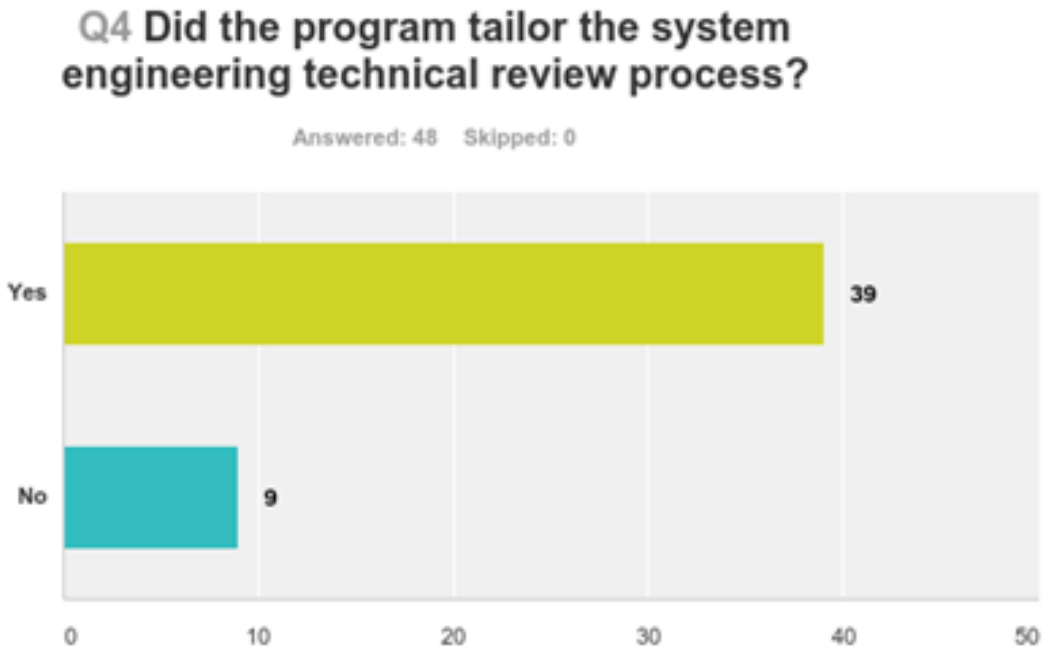

Figure 15. Question 4 Survey Results

(5) Question 5

Figure 16 provides the results to the fifth question, which is a follow on to the previous question—"If applicable, which part did you tailor?" The intent behind this question is to understand how the programs tailored by using this multi-select question. A program could respond with not applicable or multiple other options. Tailoring reviews included and entrance/exit criteria were the most common responses from survey

participants. Of the eight “other” responses, three of them included skipping required documentation. The complete set of responses provided in the free text field—”Other (please specify)”—are included in Appendix B.

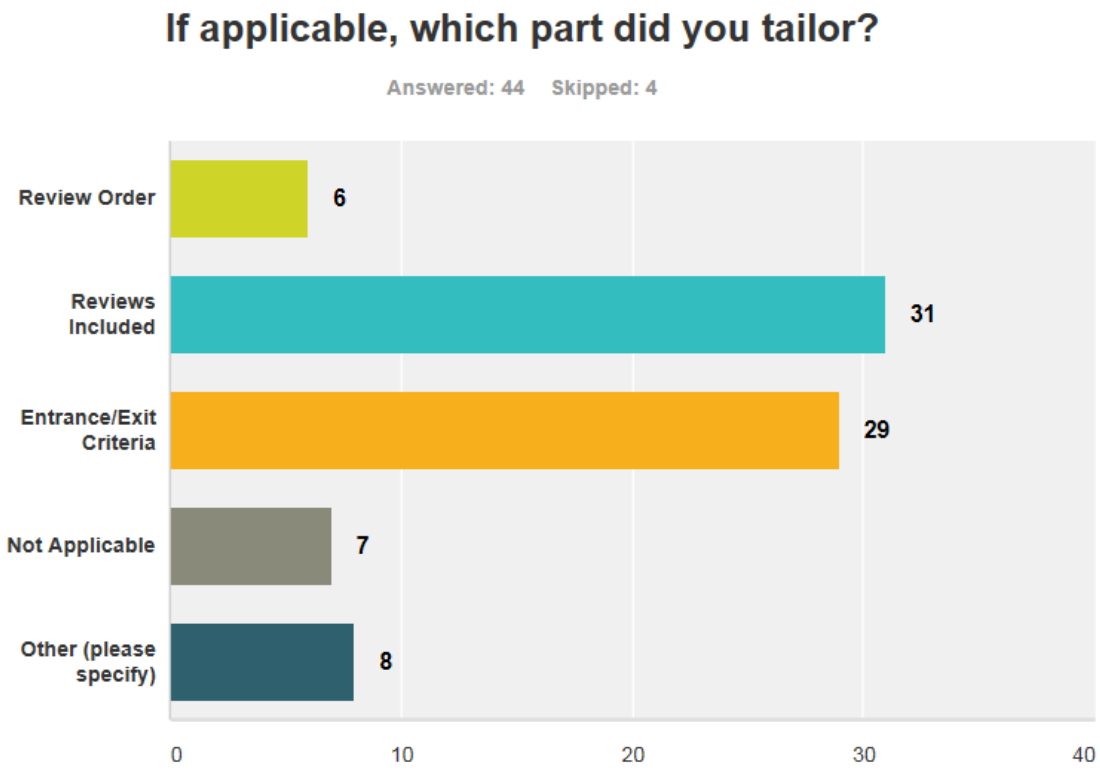

Figure 16. Question 5 Survey Results

(6) Question 6

Figure 17 provides the results to the next question—”What reviews did the program include in the SETR process?” This question was to baseline which reviews from the potential options provided in the SYSCOM policy documentation to include the known tailored reviews (e.g., NAVAIR RBR, MCSC NIR, SPAWAR SER). The most commonly included reviews were PDR, CDR, SRR, and TRR. The specific responses in the “other” category listed tailored events such as combining SRR and PDR into a single event, so there was not a consistently repeated answer. The complete set of responses provided in the free text field—”Other (please specify)”—are included in Appendix B.

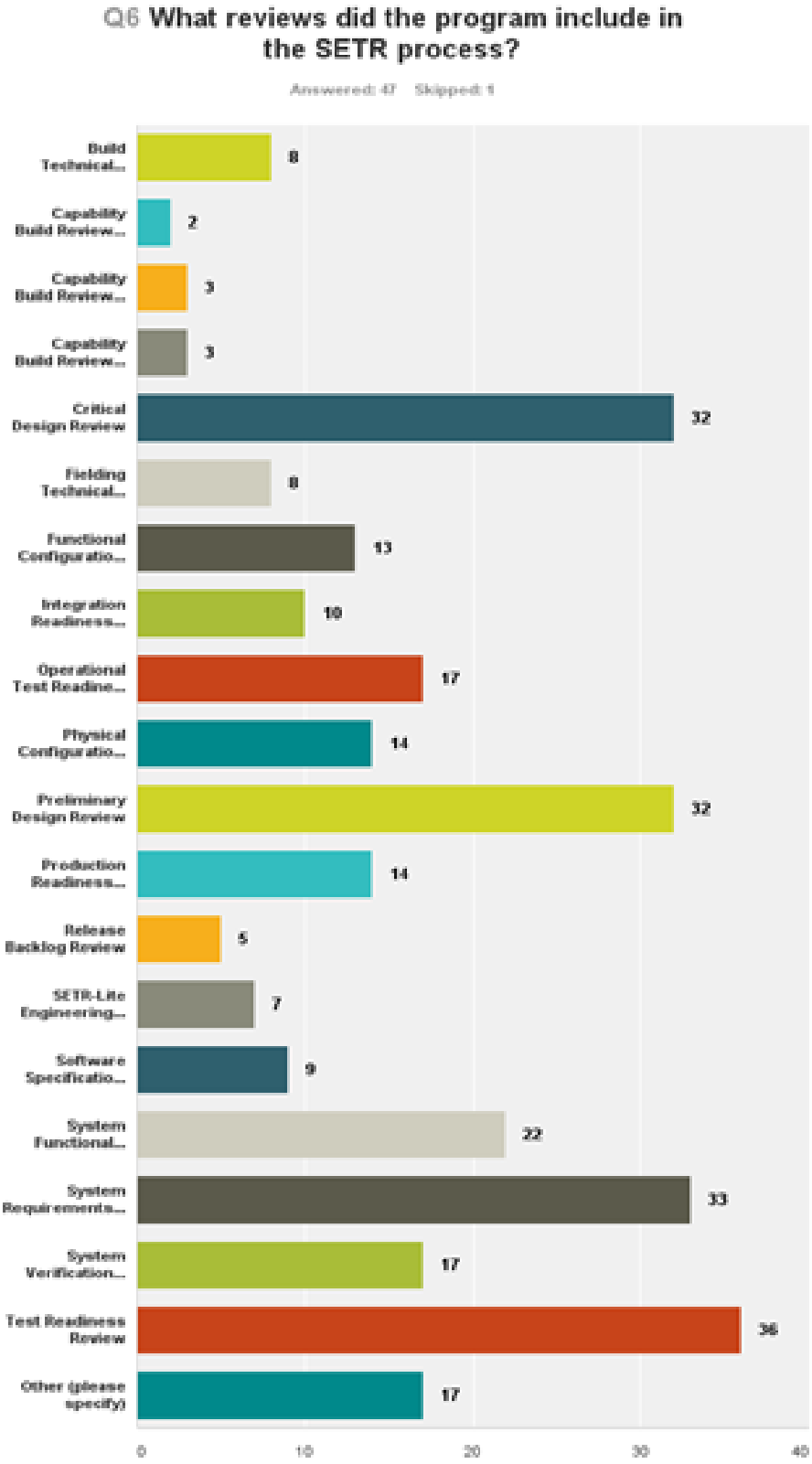

Figure 17. Question 6 Survey Results

(7) Question 7

Figure 18 provides the results to the seventh question—"Which review events did the program find most valuable to assessing the technical maturity of the program?" This question was included to address the research question focused on the critical reviews of the SETR implementation that program managers and/or lead engineers should include in a tailored implementation. The most common answer to this question was PDR, CDR, and TRR, which was closely followed by SRR. The complete set of responses provided in the free text field—"Other (please specify)"—are included in Appendix B.

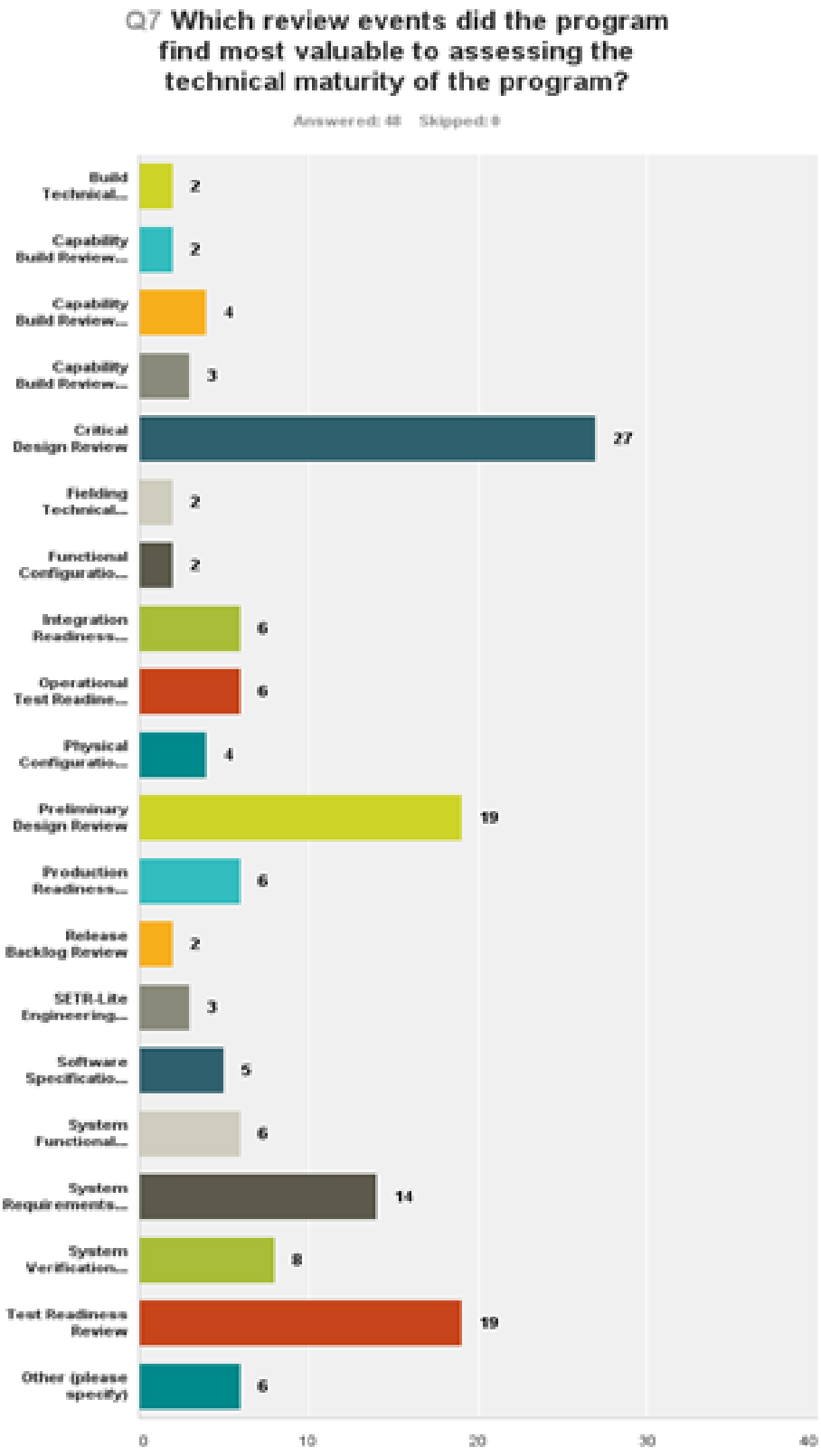

Figure 18. Question 7 Survey Results

(8) Question 8

Figure 19 provides the results to the next question—"What area of the program was adjusted based on the outcome of the SETR?" The outcome of a SETR implementation overall should be to ensure that the program is on track, or adjust based on the risk found in the review to ensure follow on phases of the acquisition process do not increase in risk. This question was intended to understand whether based on the SETR events, the program had to adjust the cost, schedule, technical design, or some other part of the program prior to proceeding to the next acquisition phase. Schedule and technical design were the top two responses indicating areas the program adjusted based on the outcome of the SETR. The complete set of responses provided in the free text field—"Other (please specify)"—are included in Appendix B.

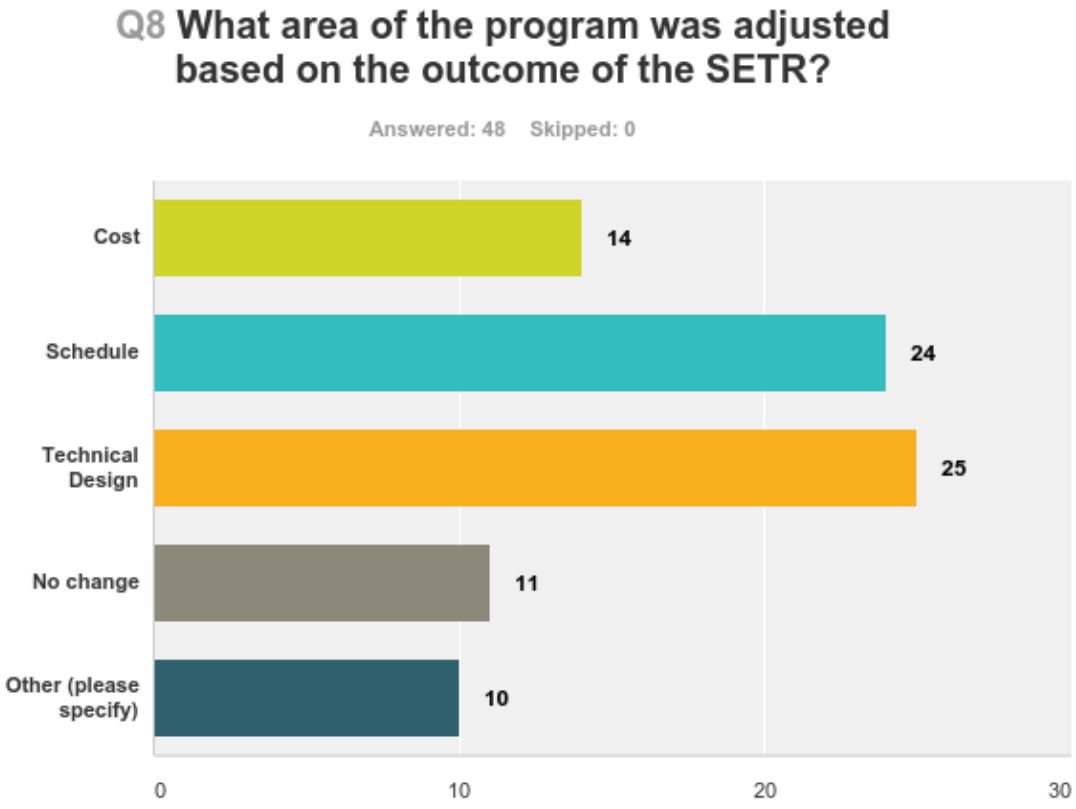

Figure 19. Question 8 Survey Results

(9) Question 9

Figure 20 provides the results to the ninth question—"By what percentage of the cost, schedule, and/or technical design was the program adjusted, if applicable?" If the answer to the previous question indicated there was an adjustment made, then this question sought to understand how significantly the program adjusted after the SETR review. If an adjustment was made to the program based on the SETR outcome, based on the responses to this survey, the change would most likely be in the 0–20% range, which was the response for over half the participants.

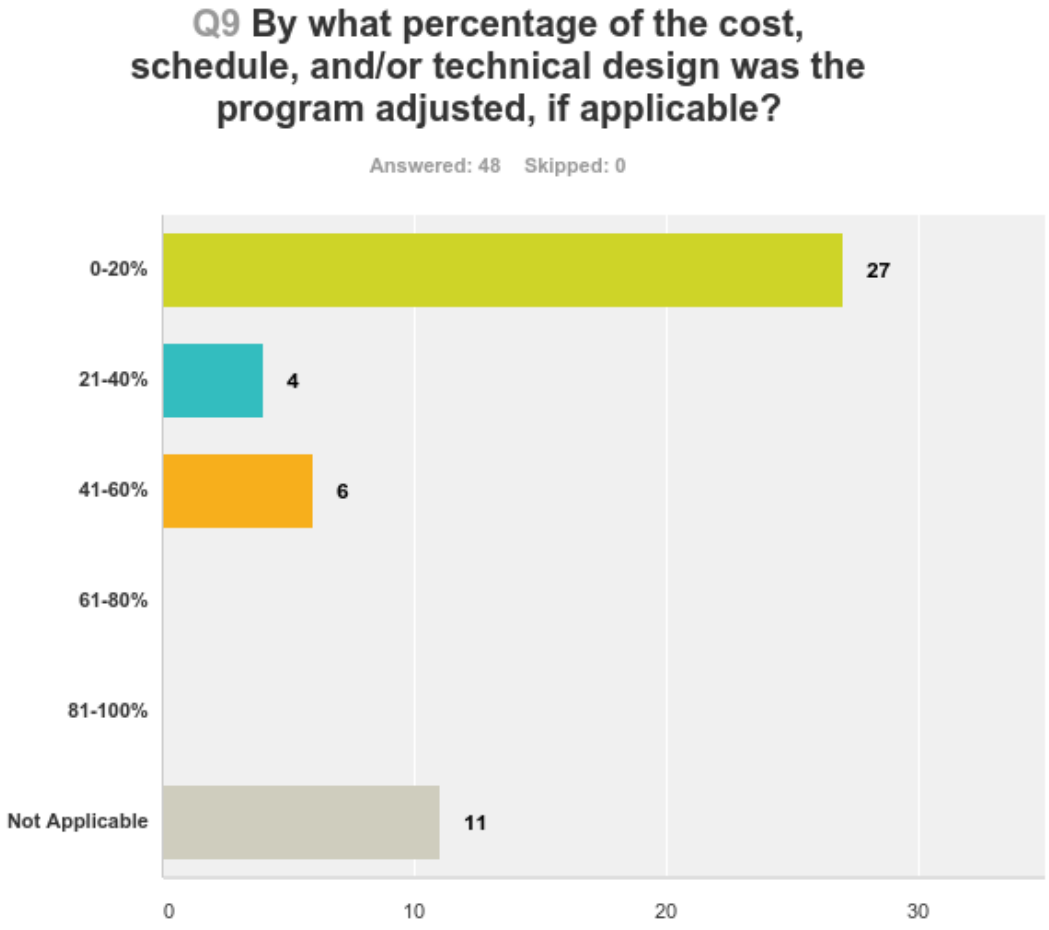

Figure 20. Question 9 Survey Results

(10) Question 10

Figure 21 provides the results to the next question—"Did any of the following options limit or create obstacles if the program tailored the SETR implementation?" This survey question aligns to a research question focused on addressing the obstacles (e.g., policy, timelines, and maturity) and risks faced by naval programs that have attempted to tailor the SETR process. More specifically do these obstacles vary based on the size of the program (e.g., ACAT I vs non program of record)? The most common response to this survey question was that the external organization created limits and/or obstacles to tailoring the SETR implementation. The complete set of responses provided in the free text field—"Other (please specify)"—are included in Appendix B.

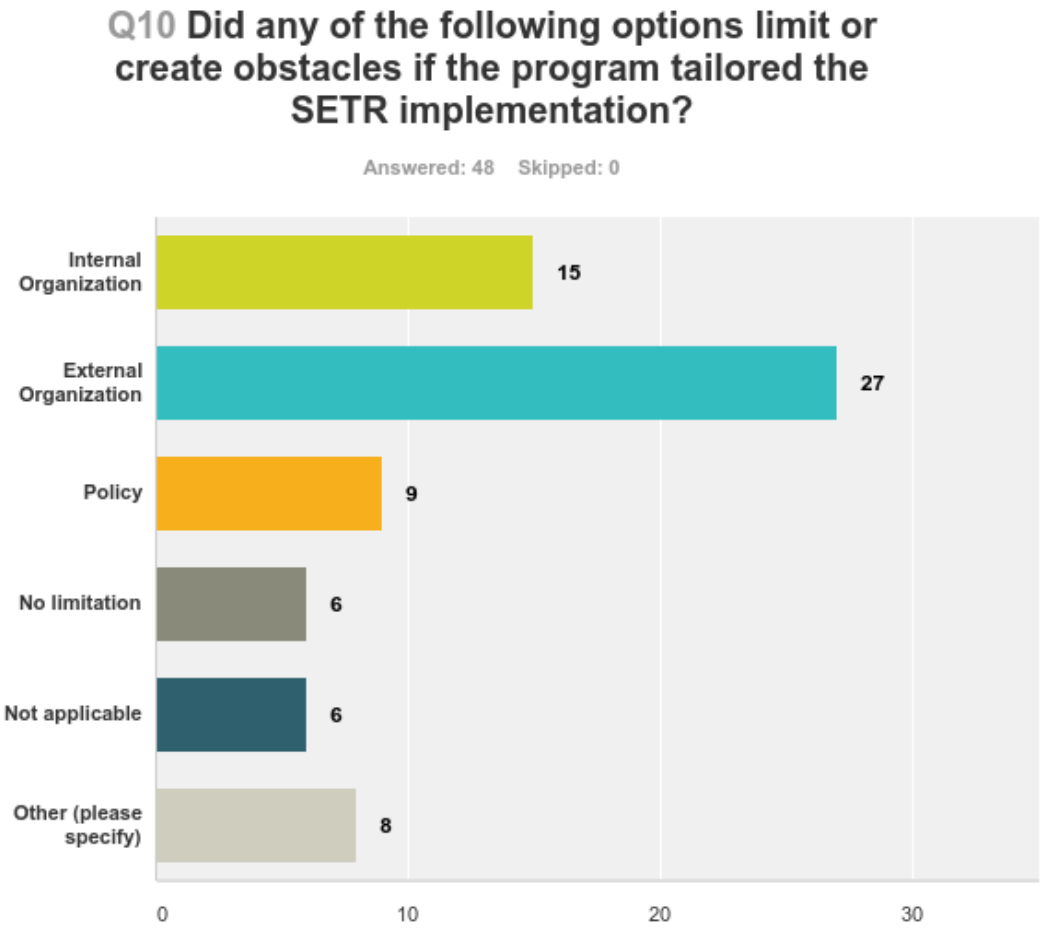

Figure 21. Question 10 Survey Results

(11) Question 11

Figure 22 provides the results to the eleventh question—"Did the program include any metrics to assess the return on investment from the reviews?" One area that was not addressed heavily in any of the government policy documentation was metrics, so this question was included to see if lack of mandatory inclusion carried through to the reviews themselves. The SPAWAR *Systems Engineering Technical Review Organization Standard Process Handbook* did include some specific metric examples as noted in Table 2. SETR implementations are iterative events throughout different phases of the program life cycle as mentioned at various points in this thesis. Metrics are one way to baseline the outcome of an event and, as follow on events occur, understand if improvements are occurring. Based on the responses to the survey, the policy seems to be indicative of the actual execution of the SETR events as almost 80% did not include any metrics to understand if there was a ROI from the reviews. The complete set of responses provided in the free text field—"Yes (please specify)"—are included in Appendix B.

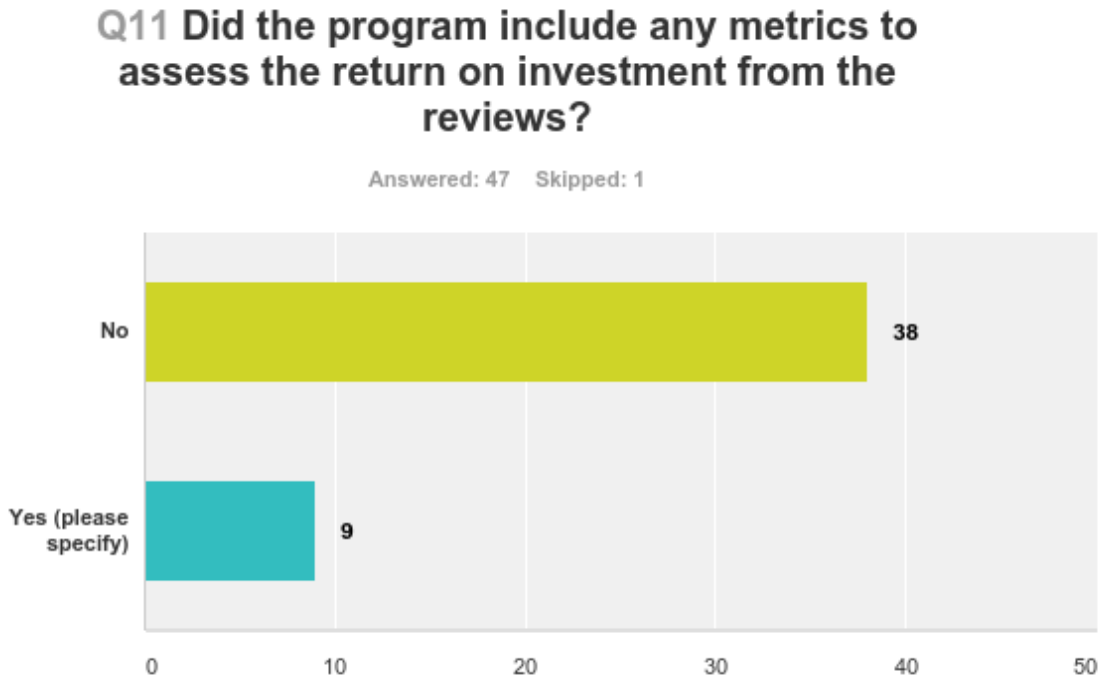

Figure 22. Question 11 Survey Results

(12) Question 12

Figure 23 provides the results to the twelfth question—"Did the program have consistent leadership throughout a complete SETR cycle?" Leadership as highlighted throughout each of the DOD, DON, and SYSCOM documentation primarily through the program PM is critical to ensuring successful SETR implementation, so this question was included to see if the programs included in the survey had consistent leadership through a complete SETR cycle. The response from this question appears fairly split with almost half having consistent leadership throughout a complete SETR cycle and the other not having consistent leadership.

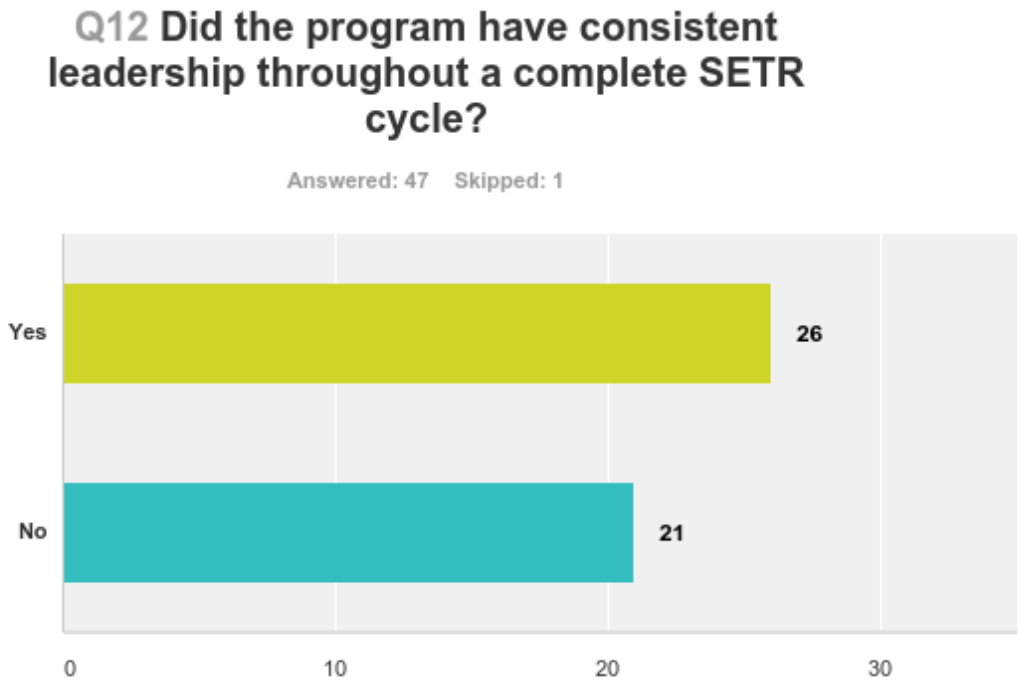

Figure 23. Question 12 Survey Results

(13) Question 13

The final question was an open ended question—"Please provide any additional feedback regarding SETR implementations." The responses varied from general feedback regarding SETR to how tailoring was implemented and included feedback on the survey

itself. The complete set of responses provided in this free text field are included in Appendix B. This chapter provided details on the method for collecting the data as well as the data gathered from the survey. Chapter V will address the research questions through survey data analysis and details from the policy and standard review to include recommendations based on the responses from the final open ended question.

C. SUMMARY

The survey was distributed across the engineering workforce SSC LANT as well as shared with the naval SYSCOMs where feasible. The target audience within these organizations was the SMEs who have expertise organizing, leading, and/or participating in a SETR event for a program. The online SurveyMonkey tool was used to distribute and collect the data from 26 April through 17 May 2017. The survey did not require a user to provide identifying information other than what organization they most closely associated with, in order to understand the breadth of SYSCOMs that were sampled in the survey. The survey questions did collect a mix of objective and subjective data points. Overall, the survey had 48 respondents, which included varying ACAT program sizes, software acquisition models, and degrees of tailoring the process. The following chapter provides the research analysis, which ties the literature review section to the data from the survey and addresses the research questions.

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V. RESEARCH ANALYSIS AND DISCUSSION

A. INTRODUCTION

This chapter provides the research analysis, which ties the literature review chapter to the survey data to address the research questions. The literature review focused on the DOD, DON, naval SYSCOM policies, and industry documentation providing direction and guidance related to the process, entrance criteria, exit criteria, leadership involvement, tailoring, and all other applicable aspect of the SETR process. Leveraging a tailored SETR implementation provides the necessary structured engineering framework while keeping up with a dynamic software development environment to meet increasing need for enhanced capability delivered to the warfighter in a shorter timeframe. Specifically, this research addresses how the SETR implementation can be tailored to most efficiently leverage resources and minimize schedule impact while addressing the acquisition, technical, and policy/legal requirements within naval software acquisitions. In order to answer this question, the following subsidiary questions will also be addressed.

1. What are the obstacles (e.g., policy, timelines, and maturity) and risks faced by naval programs that have attempted to tailor the SETR process? Do these obstacles vary based on the size of the program (e.g., ACAT I vs non program of record)?

2. What are the critical elements of the current system engineering technical review process (e.g., entrance/exit criteria, order of reviews, risk assessment) that program managers and/or lead engineers should include in a tailored implementation? What incentives or return on investment do these critical elements provide?

3. Are there any considerations/differences that should be accounted for when tailoring the process to support various acquisition models (e.g., COTS, new development, GOTS)?

4. What can engineers and program managers of future naval acquisitions learn from other programs that have attempted to tailor?

B. RESEARCH QUESTION ANALYSIS

1. Primary Research Question

The primary research question is "how can the SETR implementation be tailored to most efficiently leverage resources and minimize schedule impact while addressing the acquisition, technical, and policy/legal requirements within naval software acquisitions?" Frank Kendall, then Acting Undersecretary of Defense for Acquisition, Technology, and Logistics (AT&L), addressed the question of what is the optimal program structure, which parallels to the optimal SETR structure. The optimal SETR structure is dependent upon many variables which, IEEE 15288 Annex A provides a good reference for consideration.

> The answer to the question is either: (A) There is none, or (B) There are an infinite number. There is no one best way to structure a program. Every program has its own best structure, and that structure is dependent on all the many variables that contribute to program success or failure….There is no one solution. What I'm looking for fundamentally is the evidence that the program's leaders have thought carefully about all of the factors that I've mentioned— and many others. I look for that evidence in the nature of the product the program is acquiring and in the structure the program's leaders have chosen to use. The thinking (and the supporting data) that went into determining that specific and often unique structure is what I expect to see in an acquisition strategy, and it is what I expect our leaders to be able to explain when they present their program plans. (Kendall 2012, 23)

Over 80% of the survey respondents from across various DON organizations indicated, as shown in Figure 15, that tailoring was occurring within programs. In a tailored SETR implementation, the programs find the most ROI by tailoring entrance criteria, exit criteria, and/or which specific reviews are included based on the responses to survey question five as shown in Figure 16. Programs are primarily adjusting the schedule and/or technical design based on the outcome of the SETR events as shown in Figure 18. The percentage of adjustment could be upwards of 60% based on the response to question nine as shown in Figure 19. Over 50% of the survey respondents indicated their programs adjusted the cost, schedule, and/or technical design by up to 20%. However, fifth question's response structure leads to some uncertainty in this result as the answer

included zero as part of the option, so some respondents could have been choosing this option—"0-20%"—to indicate no change. When the response to question 8, regarding the program areas that were adjusted based on SETR outcome, are compared to the percentage of adjustment (question 9), it appears that four of the responses did select the option—"0-20%"—to indicate no change as shown in Table 5. Table 6 provides the original response count/percentages and the revised to account for this issue. The option "0-20%" still was most prevalent response with the adjustment made for this question response structure issue.

Table 5. Adjusted program areas (Question 8) Compared to Percent Adjusted (Question 9)

	0-20% (1)	21-40% (2)	41-60% (3)	61-80% (4)	81-100% (5)	NOT APPLICABLE (6)	TOTAL
Q8: Cost (A)	78.57% 11	0.00% 0	21.43% 3	0.00% 0	0.00% 0	0.00% 0	30.43% 14
Q8: Schedule (B)	62.50% 15	16.67% 4	20.83% 5	0.00% 0	0.00% 0	0.00% 0	52.17% 24
Q8: Technical Design (C)	68.00% 17	8.00% 2	16.00% 4	0.00% 0	0.00% 0	8.00% 2	54.35% 25
Q8: No change (D)	36.36% 4	0.00% 0	0.00% 0	0.00% 0	0.00% 0	63.64% 7	23.91% 11
Total Respondents	27	4	6	0	0	9	46

Table 6. Revised Response Calculations

Question 9: By what percentage of the cost, schedule, and/or technical design was the program adjusted, if applicable?				
Answer Options	**Response Percent**	**Response Count**	**Revised Response Percent**	**Revised Response Count**
0-20%	56.3%	27	47.9%	23
21-40%	8.3%	4	8.3%	4
41-60%	12.5%	6	12.5%	6
61-80%	0.0%	0	0.0%	0
81-100%	0.0%	0	0.0%	0
Not Applicable	22.9%	11	31.3%	15
answered question		48		
skipped question		0		

When comparing the respondent's response of what was tailored in the program (question 5) to the percentage the program cost, schedule, and/or technical design (question 9) was adjusted as shown in Table 7, the programs that tailored the SETR implementation focusing the tailoring on which reviews to include seemed to have the largest return based on the percent the program was adjusted. In addition, fewer SETR events should indicate less time and resources spent preparing for unneeded reviews. Additional statistical analysis should be performed in this area.

Table 7. SETR Areas Tailored (Question 5) Compared to Percent Adjusted (Question 9)

	0-20% (1)	21-40% (2)	41-60% (3)	61-80% (4)	81-100% (5)	NOT APPLICABLE (6)	TOTAL
Q5: Review Order (A)	16.67% 1	16.67% 1	33.33% 2	0.00% 0	0.00% 0	33.33% 2	13.95% 6
Q5: Reviews Included (B)	54.84% 17	9.68% 3	19.35% 6	0.00% 0	0.00% 0	16.13% 5	72.09% 31
Q5: Entrance/Exit Criteria (C)	65.52% 19	3.45% 1	13.79% 4	0.00% 0	0.00% 0	17.24% 5	67.44% 29
Q5: Not Applicable (D)	57.14% 4	0.00% 0	0.00% 0	0.00% 0	0.00% 0	42.86% 3	16.28% 7
Total Respondents	24	3	6	0	0	10	43

Metrics to track the ROI throughout SETR implementation is an item that is difficult to address based on respondent's answers to survey question eleven as shown in Figure 22. Only nine respondents indicated that any metrics were included in the SETR process. In reviewing the additional details provided in the open ended response area for this question, most metrics were number of items completed (e.g., action item tracking). A higher level of action items completed is not necessarily a metric of success as it could indicate that the program should not have entered the event in the first place because the program was not sufficiently ready. Future research would be valuable in this area as the policy and other documentation did not add much direction and/or examples. From a literature review perspective, SPAWAR *Systems Engineering Technical Review*

Organization Standard Process Handbook was the only document that addressed metrics beyond a brief mention.

2. Subsidiary Question 1

The first subsidiary question is "what are the obstacles (e.g., policy, timelines, and maturity) and risks faced by naval programs that have attempted to tailor the SETR process? Do these obstacles vary based on the size of the program (e.g., ACAT I vs non program of record)?" More than 50% of the survey respondents indicated that "External Organizations" created the most obstacles (question 10) as shown in Figure 21. Interestingly, when reviewing the "other" free form responses, five of the nine responses could have also been categorized as "External Organization" as shown in Table 8. When looking at the responses to question 10 through the lens of the program size (e.g., ACAT I, ACAT II), it does not seem to affect the response as "External Organization" is consistently the response more than 50% of the time as shown in Table 9. Future research should include statistical analysis in this area.

Table 8. Categorization of "Other" Survey Responses for Question 10

	Question 10: Other (please specify)	Categorization
1	It depends. For instance, if the PM/LSE uses a SETR event that senior leadership/MDA is not familiar with, then it may result in additional exchanges between the PM and senior leadership/MDA to educate both sides until both sides agree on how it will be addressed and executed.	External Organization
2	Every Navy 'Heavy-weight' that controls money in the budget thinks they can become a computer guru by buying the latest and greatest product that a salesperson can talk them into, and don't seem to realize that all requirements of ANY systems should be known PRIOR TO any purchase. Money to spend doesn't make a manager an expert, and they will be rotated out of that job in (usually) three years (or less) when someone else will come in and make decisions all over again. If you don't know how a present system runs (to fulfill all the laws, policies, required today), then how can you say that you are an expert qualified to replace that system. If you force the conversion on partial knowledge then the risk of failure increases and all members of that service suffer and Congress is unhappy. Why? Because they controlled the budget and had the authority but did not have sufficient knowledge, or training, or experience, to make the right call knowing the risks.	External Organization
3	Personnel– The organization was not staffed with the appropriate number of people. Skillset -The work force was not trained for the positions they held.	Internal Organization

	Question 10: Other (please specify)	Categorization
4	PMW 240, as a portfolio of smaller programs, is built around the idea that the SETR process needs to be tailored for each, individual program; leadership is also aware that defense business systems, especially unmodified COTS implementations, are unique among DOD acquisitions, which necessitates modifications to the SETR process	Internal Organization
5	The Program Manager did not and currently does not care for engineers. They "get in his way." Maybe that's why his program is failing...?	Internal Organization
6	Actual SETR events were determined by MCSC leadership external to the Program Office.	External Organization
7	There is very few tailoring guidelines. This leads to significant disagreement about what tailoring is acceptable. This problem exists at all levels. Take architecture for example: the DoDAF specifications are vague on tailoring, the Navy Architecture Development Guide does not directly address tailoring, and the SPAWAR architecture review guidelines (used by contractors to conduct reviews) make no provision for tailoring. Until tailoring is addressed directly at all levels from policy to review guidelines, attempting to tailor will lead to significant friction, frustration, and delays.	External Organization
8	The external organizations (user and customer) were not involved in the review. Obstacles arose in the approval of a design that the user had never seen and making design decisions driving cost and schedule that the customer did not have input to change.	External Organization

Table 9. Size of Program (Question 2) Compared to Obstacles (Question 10)

	INTERNAL ORGANIZATION (1)	EXTERNAL ORGANIZATION (2)	POLICY (3)	NO LIMITATION (4)	NOT APPLICABLE (5)	OTHER (PLEASE SPECIFY) (6)	TOTAL
Q2: ACAT I (A)	29.41% 5	58.82% 10	17.65% 3	11.76% 2	11.76% 2	17.65% 3 Responses	86.21% 25
Q2: ACAT II (B)	0.00% 0	100.00% 1	0.00% 0	0.00% 0	0.00% 0	0.00% 0 Responses	3.45% 1
Q2: ACAT III (C)	18.18% 2	54.55% 6	0.00% 0	9.09% 1	18.18% 2	18.18% 2 Responses	44.83% 13
Total Respondents	7	17	3	3	4	5	29

3. Subsidiary Question 2

The second subsidiary question is "what are the critical elements of the current system engineering technical review process (e.g., entrance/exit criteria, order of reviews, risk assessment) that program managers and/or lead engineers should include in a tailored implementation? What incentives or return on investment do these critical elements

provide?" Based on the survey responses when a program tailors its SETR implementation, the primary focus is on the reviews included and what entrance and/or exit criteria is included. Interestingly, in the open-ended responses to survey question 5 the respondents agreed that tailoring the acquisition documentation was another key area of focus. When determining which events were most valuable (question 7) to include in the tailored SETR implementation, PDR, CDR, and TRR ranked 20% points or greater than any of the other survey options. This research question would benefit in future research from additional statistical analysis to better tie the return on investment to the type of tailoring that was implemented.

4. Subsidiary Question 3

The third subsidiary question is "are there any considerations/differences that should be accounted for when tailoring the process to support various acquisition models (e.g., COTS, new development, GOTS)?" Based on comparison of the responses in questions 3 and 4, the software acquisition model does not affect whether the program tailored the SETR implementation or not as shown in Table 10. Further, Table 11 indicates that the software acquisition model does not affect a program's focus on SETR tailoring from the three primary elements: the reviews included, entrance criteria, and exit criteria.

Table 10. Software Acquisition Model (Question 3) Compared to if SETR Tailored (Question 4)

	YES (1)	NO (2)	TOTAL
Q3: Commercial off the Shelf (A)	80.95% 17	19.05% 4	60.00% 21
Q3: Government off the Shelf (B)	75.00% 3	25.00% 1	11.43% 4
Q3: New Development (C)	90.00% 9	10.00% 1	28.57% 10
Total Respondents	29	6	35

Table 11. Software Acquisition Model (Question 3) Compared to SETR Areas Tailored (Question 5)

	REVIEW ORDER (1)	REVIEWS INCLUDED (2)	ENTRANCE/EXIT CRITERIA (3)	NOT APPLICABLE (4)	OTHER (PLEASE SPECIFY) (5)	TOTAL
Q3: Commercial off the Shelf (A)	26.32% 5	73.68% 14	63.16% 12	21.05% 4	21.05% 4 Responses	121.88% 39
Q3: Government off the Shelf (B)	0.00% 0	75.00% 3	50.00% 2	25.00% 1	0.00% 0 Responses	18.75% 6
Q3: New Development (C)	11.11% 1	88.89% 8	77.78% 7	0.00% 0	11.11% 1 Responses	53.13% 17
Total Respondents	6	25	21	5	5	32

When comparing the software acquisition model (question 3) to the specific reviews included (question 6) as shown in Table 12, the COTS and new development models included most consistently the PDR and CDR as SETR events, which is not surprising these are the two reviews given DODI 5000.02 includes the requirement for these two reviews along with specific criteria on when the requirement applies. Expectations for these two events are better understood and engrained in the culture due to this guidance being at the DOD level. The comparison data on the GOTS software acquisition model is more evenly distributed across the review types as only four respondents fell into this software acquisition model, so more data would be needed to verify if this holds true for a GOTS software acquisition model.

Table 12. Software Acquisition Model (Question 3) Compared to Specific Reviews Included (Question 6)

	Q3: COMMERCIAL OFF THE SHELF (A)	Q3: GOVERNMENT OFF THE SHELF (B)	Q3: NEW DEVELOPMENT (C)	TOTAL
Build Technical Review (1)	60.00% 3	20.00% 1	20.00% 1	14.71% 5
Capability Build Review - Initial (2)	50.00% 1	0.00% 0	50.00% 1	5.88% 2
Capability Build Review - Design (3)	66.67% 2	0.00% 0	33.33% 1	8.82% 3
Capability Build Review - Readiness (4)	66.67% 2	33.33% 1	0.00% 0	8.82% 3
Critical Design Review (5)	54.17% 13	8.33% 2	37.50% 9	70.59% 24
Fielding Technical Review (6)	50.00% 3	33.33% 2	16.67% 1	17.65% 6
Functional Configuration Audit (7)	50.00% 5	20.00% 2	30.00% 3	29.41% 10
Integration Readiness Review (8)	44.44% 4	0.00% 0	55.56% 5	26.47% 9
Operational Test Readiness Review (9)	50.00% 6	25.00% 3	25.00% 3	35.29% 12
Physical Configuration Audit (10)	54.55% 6	18.18% 2	27.27% 3	32.35% 11
Preliminary Design Review (11)	52.17% 12	8.70% 2	39.13% 9	67.65% 23
Production Readiness Review (12)	54.55% 6	0.00% 0	45.45% 5	32.35% 11
Release Backlog Review (13)	25.00% 1	0.00% 0	75.00% 3	11.76% 4
SETR-Lite Engineering Review (14)	40.00% 2	40.00% 2	20.00% 1	14.71% 5
Software Specification Review (15)	28.57% 2	14.29% 1	57.14% 4	20.59% 7
System Functional Review (16)	41.18% 7	17.65% 3	41.18% 7	50.00% 17
System Requirements Review (17)	60.00% 15	8.00% 2	32.00% 8	73.53% 25
System Verification Review (18)	42.86% 6	7.14% 1	50.00% 7	41.18% 14
Test Readiness Review (19)	55.56% 15	11.11% 3	33.33% 9	79.41% 27
Other (please specify) (20)	70.00% 7 Responses	10.00% 1 Responses	20.00% 2 Responses	29.41% 10
Total	20	4	10	34

5. Subsidiary Question 4

The fourth subsidiary question is "what can engineers and program managers of future naval acquisitions learn from other programs that have attempted to tailor?" The final open ended survey question as well as the "other" free form response areas in various questions provided the most valuable, direct insight to address this question. One survey respondent of the open-ended question included the following:

> While SETR is a great tool to assess where a program is in the time of the event. We are normally limited in time and resources on how deep to conduct the review. We are also limited to the information that the programs provide.

> I had an instance where the performers provided all the necessary information, everything appeared on schedule for delivery and the SETR went by smoothly. I later found out that the performers were 11 months behind schedule, but this was not apparent with the provided documentation.

> While SETR is a good tool, it is often cumbersome to the programs to support this effort while still performing their daily tasks.

Time and resource constraints are key reasons that tailoring is typically considered. However, as noted in the respondent's comment, the review and associated artifacts being evaluated should be carefully selected to hit the critical areas without adding unnecessary overhead on the program, avoid causing the SETR event to become a "check-the-box" event, and/or miss risks such as being eleven months behind schedule. Based on the survey results, key concepts that are most impactful to a tailored SETR implementation's success are as follows:

- engage leadership
- focus on preparation
- maintain early and often communication
- educate stakeholders

Leadership engagement came up repeatedly through-out the survey responses. As Secretary Kendall states in his description of the optimal program structure, the

individual's thinking is a critical piece, which requires an engaged leader (Kendall 2012, 23). The program's SETR leadership should seek out other program lessons learned including potential review templates when determining how they are going to structure the implementation. Similarly, once the program has initiated SETR events, the program SETR leadership should willingly look for opportunities to share with other programs to ensure best practices continue to evolve. One respondent highlighted a leadership challenge with respect to engaging and understanding the variables to address in order to avoid events becoming "a 'check-the-box' sort of event if the program is required to complete every single SETR review, or even to address every single 'bullet point' for a given review…SETR reviews are absolutely necessary, but forcing programs to complete reviews that are extraneous given their specific situation leads to increased costs, schedule, etc." As noted in the literature review, the PM is the ultimate recipient of the SETR report that captures the confidence level of the baseline (DON SPAWAR 2009, 1012). The manner in which the PM addresses the report sends a direct message to the rest of the program. By choosing to take an active role in ensuring action items or other issues are addressed, the PM lets the rest of the program office know that SETR implementation is not a "check-the-box" sort of event.

SETR events require focused preparation, which is probably best described in the following SYSCOM documents that provide detailed preparation information (e.g., scheduling, review elements) for each review:

- NAVSEA 05H *Technical Review Manual*, Version 2.0, 18 December 2009: Appendix includes detailed descriptions of entrance and exit criteria for each SETR event, different documentation, architectural views, and scheduling details.
- NAVAIR *Adapting Acquisition to Agile Software Development: A How-To Guide*, Version 2.0, 19 March 2014: Provides execution level details on the RBR.
- MCSC *SETR Handbook* (SIAT-HDBK-001): Detailed appendix for each SETR event that includes an event overview, entrance criteria, review elements, agenda, exit criteria, and evaluation criteria.

As noted by a survey respondent, the SETR events "typically take a block of preparatory time and resolution time to address RFAs;" however, "the benefit is that

multiple SETR events ensure documentation is being updated as the program matures versus the documents becoming static and outdated." The program must balance focused preparation with ensuring the program is looking at what events will provide the most ROI for the program such as the PDR or CDR prior to jumping in and just "checking the box."

Early and often communication was a concept that developed when reviewing the survey responses as well as literature review to enable management of expectations and reduce risk in executing a tailored SETR event. As a respondent noted "managing expectations & frequent sync sessions are critical to success. Echelon 2 & Echelon 3 have different interpretations of what is expected regarding the level of completeness of each SETR." Waiting until the program has fully vetted internally the tailored SETR implementation without reaching out to external stakeholders increases the time and chances of obstacles being put in the program's path. SETR should be looked at as a way to engage users, internal and external stakeholders to deal with risks before they become issues in an open transparent manner, which requires early and often communication.

Similarly, educating stakeholders is a key piece to ensuring success with a tailored SETR implementation. The SETR implementation whether tailored or not must be documented in the program's SEP, which is generally signed by individuals outside of the program office. Due to this, if the program determines that a tailored SETR implementation is best then the program must educate not only the participants of the event, but also external stakeholder(s) that have to approve the SEP. This could take significant amount of time as one respondent noted, "if the PM/LSE uses a SETR event that senior leadership/MDA is not familiar with, then it may result in additional exchanges between the PM and senior leadership/MDA to educate both sides until both sides agree on how it will be addressed and executed." As noted in the literature review section, there are a few tailored SETR implementation examples documented in DOD, DON, or naval SYSCOM documents to lean on during this discussion, which one respondent noted "until tailoring is addressed directly at all levels from policy to review guidelines, attempting to tailor will lead to significant friction, frustration, and delays" as the program has to overcome the culture of what people find acceptable. Without

supportive program leadership, overcoming this culture could prove too difficult for some SETR leadership teams leading to the “check-the-box” mentality.

C. SUMMARY

Leveraging a tailored SETR implementation provides the necessary structured engineering framework while keeping up with a dynamic software development environment to meet increasing need for enhanced capability delivered to the warfighter in a shorter timeframe. Over 80% of the survey respondents from across various DON organizations indicated, as shown in Figure 15, that tailoring was occurring within programs to address program specific needs such as aggressive schedule and leveraging an agile software development models. The tailored SETR events are directly impacting the program’s next phase through technical design adjustments and other key program variables. The reviews included specifically the PDR and CDR, as well as entrance and exit criteria, as the aspects that programs find provide a ROI. This is the case for both COTS and new development software acquisition models. Factors external to the organization continue to be the primary obstacle no matter the program size determining the ability to successfully tailor and implement the SETR process based on the responses to the direct survey questions and open ended questions. Future naval software acquisition programs should engage leadership, focus on preparation, maintain early and often communication, and educate stakeholders to improve ROI of the tailored SETR implementation. The following chapter presents the conclusions from the research and suggestions for follow on research.

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VI. CONCLUSION

A. INTRODUCTION

According to the *Naval SYSCOM Systems Engineering Policy* (2009), the SETR process should be an event-driven process that consists of one or more programmatically independent reviews with defined entrance and exit criteria. The SETR reviews assess the technical health, requirements accuracy, design maturity, testing effectiveness, and sustainment support over the program life cycle. The jointly signed SYSCOM policy states that the program SETR events, along with the event entrance and exit criteria, are documented in the SEP which is signed by the program MDA or other designated authority based on the program ACAT level. The SYSCOM policy notes that event closure normally occurs only after the exit criteria has been met, but the SETR TRB chair must concur with the identified action items along with any plan of action and milestones and/or mitigations. According to the policy, the SETR output ultimately informs the PM if the program is technically ready to move on to the next phase of the acquisition process.

From a policy perspective, the DOD and DON directives and instructions lay the systems engineering foundation for the naval SYSCOM guidance regarding SETR implementation. In addition, the Navy has emphasized the need to deliver capability versus systems, and acquisition is impacted by this capability vision requiring innovative application of SETR for the SoS or platform level efforts, which traditional SETR is not well structured to support. Leveraging a tailored SETR implementation provides the necessary structured engineering framework while keeping up with a dynamic software development environment to meet increasing need for enhanced capability delivered to the warfighter in a shorter timeframe. More than 80% of the survey respondents from across various DON organizations indicated, as shown in Figure 15, that tailoring was occurring within programs to address program specific needs such as aggressive schedule and leveraging an agile software development model. The tailored SETR events are directly impacting the program's next phase through technical design adjustments and other key program variables. The reviews included specifically the PDR and CDR, as

well as entrance and exit criteria, as the aspects that programs find provide a ROI when tailoring the SETR implementation. This is the case for both COTS and new development software acquisition models. Factors external to the organization continue to be the primary obstacle no matter the program size determining the ability to successfully tailor and implement the SETR process.

B. RECOMMENDATIONS

Future naval software acquisition programs should engage leadership, focus on preparation, maintain early and often communication, and educate stakeholders to improve ROI of the tailored SETR implementation. As Secretary Kendall states in his description of the optimal program structure, the individual's thinking is a critical piece, which requires engaged leaders (Kendall 2012, 23). Seeking out other program lessons learned prior to determining how to tailor the program's SETR implementation will reduce the likelihood of tailored implementations that provide no ROI on the program's SETR implementation.

Similarly, once the program has initiated SETR events the program SETR leadership should willingly look for opportunities to share with other programs to ensure best practices continue to evolve. The program must balance focused preparation with ensuring the program is including reviews in the tailored implementation that will provide the most ROI for the program (such as the CDR) prior to jumping in and just "checking the box."

Educating stakeholders is a key piece to ensuring success with a tailored SETR implementation. Additionally, waiting until the program has fully vetted internally the tailored SETR implementation without reaching out to communicate with external stakeholders increases the time and chances of obstacles being put in the program's path. SETR should be looked at as a way to engage users, internal and external stakeholders to deal with risks before they become issues in an open transparent manner, which requires early and often communication. The SETR implementation, whether tailored or not, must be documented in the program's SEP, which is generally signed by individuals outside of the program office. Due to this, if the program determines that a tailored SETR

implementation is best, then the program must educate not only the participants of the event, but also external stakeholders that have to approve the SEP. This could take significant amount of time. As noted in the literature review section, there are a few tailored SETR implementation examples documented in DOD, DON, or naval SYSCOM documents to lean on during this discussion. Without supportive program leadership, overcoming this culture could prove too difficult for some SETR leadership teams leading to the "check-the-box" mentality.

From a policy prospective, tailoring needs to be addressed directly at all levels to avoid significant friction, frustration, and delays. Ideally, the SYSCOM guidance or supplemental documentation should provide examples of successfully tailoring and lessons learned that future naval programs can use as a starting point to avoid having to learn the lessons the hard way. Additionally, the SYSCOM level documentation should address minimal level metrics to objectively measure SETR implementation ROI to ensure the events are not "check-the-box" events, which only serve to drain already constrained resources within the program.

C. FUTURE RESEARCH

As the DON continues to focus priorities around delivering capabilities versus individuals systems, additional research to improve the SETR implementation across the department is critical, especially to stay current with industry software best practices, which is leading to more rapid software deployments. Then-Secretary Gates framed the challenge in a September 2008 speech. "Our conventional modernization programs see a 99% solution in years. Stability and counterinsurgency—the wars we are in—require a 75% solution in months. The challenge is whether in our bureaucracy and in our minds these two different paradigms can be made to coexist" (SEI 2011, xi). Warfighters always benefit from finding ways to reduce the bureaucracy and deliver enhanced capabilities in a shorter timeframe addressing the dynamic threats they face daily. The alternative to allowing bureaucracy to triumph, from a DON perspective, has potential consequences such as loss of life that should motivate every individual involved in the SETR implementation to achieve the greatest ROI in the shortest amount of time.

More than 80% of survey respondents stated that the program did not include metrics to assess the ROI of the SETR reviews. From a literature review perspective, SPAWAR *Systems Engineering Technical Review Organization Standard Process Handbook* was the only document that addressed metrics beyond a brief mention. Research identifying metrics to assess ROI would not only help future programs from a lesson learned perspective, but also could help programs executing the SETR event understand how to adjust future reviews gaining more value on what can be delivered to the warfighter. Another related research area is the average SETR investment from the program as it relates to the average ROI (e.g., cost savings, schedule savings). This research would benefit holistically from additional statistical analysis to better tie the return on investment to the type of tailoring that was implemented.

Beyond metrics, an area that developed during this research due to DODI 5000.75 being published was the difference in a SETR event for a business system versus a national security system. DODI 5000.75 supersedes DODI 5000.02 for all business system acquisition, which directs alignment "to commercial best practices and will minimize the need for customization of commercial products to the maximum extent possible" (DOD 2017, 4). This should lead to more accepted use of SETR tailoring, which will provide opportunities to further this research.

D. SUMMARY

This research provides tailored SETR implementation recommendations based on lessons learned on how to increase positive ROI for a naval software acquisitions program. The recommendations will assist program leadership in making better decisions on where to allocate software engineering resources within the schedule and funding constraints. While the thesis is focused on the DON, the recommendations are applicable to SETR implementations for software acquisitions programs across the broader DOD. In addition, three future research topics are provided based on areas that came up in this effort that could be expanded upon. Tailored SETR implementation has not been heavily researched specifically as it relates to software acquisition programs, so there is a significant opportunity to positively impact the product the warfighter receives.

APPENDIX A. LEADING INDICATORS

The following tables show leading indicators in relation to IEEE Standard 15288.

Table 4 - LEADING INDICATORS APPLICATION PER ISO/IEC 15288

	Requirements Trends	System Definition Change Backlog Trend	Interface Trends	Requirements Validation Trends	Requirements Verification Trends	Work Product Approval Trends	Review Action Closure Trends	Risk Exposure Trends	Risk Treatment Trends	Technology Maturity Trends	Technical Measurement Trends	Systems Engineering Staffing & Skills Trends	Process Compliance Trends	Test Completeness Trends	Facility and Equipment Availability Trends	Defect/Error Trends	System Affordability Trends	Architecture Trends	Schedule and Cost Pressure
6.3 Project Processes																			
6.3.1 Project Planning Process																			
6.3.1.3.a Define the project																			
6.3.1.3.b Plan the project resources												x			x				x
6.3.1.3.c Plan the project technical and quality management						x	x									x			
6.3.1.3.d Activate the project																			
6.3.2 Project Assessment and Control Process																			
6.3.2.3.a Assess the project						x	x					x	x		x	x			x
6.3.2.3.b Control the project						x	x					x	x		x	x			x
6.3.2.3.c Close the project																			
6.3.3 Decision Management Process																			
6.3.3.3.a Plan and define decisions										x							x		
6.3.3.3.b Analyze the decision information										x							x		
6.3.3.3.c Track the decision										x							x		
6.3.4 Risk Management Process																			
6.3.4.3.a Plan Risk Management																			
6.3.4.3.b Manage Risk Profile																			
6.3.4.3.c Analyze Risks								x											
6.3.4.3.d Treat Risks								x	x										
6.3.4.3.e Monitor Risks								x	x										
6.3.4.3.f Evaluate Risk Management Process								x	x										
6.3.5 Configuration Management Process																			
6.3.5.3.a Plan configuration management																			
6.3.5.3.b Perform configuration management		x																	

Table 4 - LEADING INDICATORS APPLICATION PER ISO/IEC 15288																			
	Requirements Trends	System Definition Change Backlog Trend	Interface Trends	Requirements Validation Trends	Requirements Verification Trends	Work Product Approval Trends	Review Action Closure Trends	Risk Exposure Trends	Risk Treatment Trends	Technology Maturity Trends	Technical Measurement Trends	Systems Engineering Staffing & Skills Trends	Process Compliance Trends	Test Completeness Trends	Facility and Equipment Availability Trends	Defect/Error Trends	System Affordability Trends	Architecture Trends	Schedule and Cost Pressure
6.3.6 Information Management Process																			
6.3.6.3.a Plan information management																			
6.3.6.3.b Perform information management		x																	
6.4 Technical Processes																			
6.4.1 Stakeholder Requirements Definition Process																			
6.4.1.3.a Elicit Stakeholder Requirements	x																		
6.4.1.3.b Define Stakeholder Requirements	x																x		
6.4.1.3.c Analyze and Maintain Stakeholder Requirements	x	x		x							x						x		
6.4.2 Requirements Analysis Process																			
6.4.2.3.a Define System Requirements	x																x		
6.4.2.3.b Analyze and Maintain System Requirements	x	x		x	x						x						x		
6.4.3 Architectural Design Process																			
6.4.3.3.a Define Architecture			x							x							x	x	
6.4.3.3.b Analyze and Evaluate Architecture			x							x	x						x	x	
6.4.3.3.c Document and Maintain Architecture		x	x															x	
6.4.4 Implementation Process																			
6.4.4.3.a Plan implementation																			
6.4.4.3.b Perform implementation											x								
6.4.5 Integration Process																			
6.4.5.3.a Plan integration														x					
6.4.5.3.b Perform integration											x			x					
6.4.6 Verification Process																			
6.4.6.3.a Plan verification					x									x					

Table 4 - LEADING INDICATORS APPLICATION PER ISO/IEC 15288																			
	Requirements Trends	System Definition Change Backlog Trend	Interface Trends	Requirements Validation Trends	Requirements Verification Trends	Work Product Approval Trends	Review Action Closure Trends	Risk Exposure Trends	Risk Treatment Trends	Technology Maturity Trends	Technical Measurement Trends	Systems Engineering Staffing & Skills Trends	Process Compliance Trends	Test Completeness Trends	Facility and Equipment Availability Trends	Defect/Error Trends	System Affordability Trends	Architecture Trends	Schedule and Cost Pressure
6.4.6.3.b Perform verification					x									x					
6.4.8 Validation Process																			
6.4.8.3.a Plan validation				x										x					
6.4.8.3.b Perform validation				x										x					
6.4.10 Maintenance Process																			
6.4.10.3.a Plan maintenance										x									
6.4.10.3.b Perform maintenance										x									

APPENDIX B. COMPLETE SURVEY DATA

Question 1: Which organization are you most closely associated with?		
Answer Options	**Response Percent**	**Response Count**
Department of Defense	4.2%	2
Department of Navy	27.1%	13
Marine Corps Systems Command	6.3%	3
Naval Air Systems Command	2.1%	1
Naval Facilities Engineering Command	0.0%	0
Naval Sea Systems Command	2.1%	1
Naval Supply Systems Command	2.1%	1
Space and Naval Warfare Systems Command	54.2%	26
Other	2.1%	1
answered question		**48**
skipped question		**0**

Question 2: What is the size of the program that used the SETR process?		
Answer Options	**Response Percent**	**Response Count**
ACAT I	35.4%	17
ACAT II	2.1%	1
ACAT III	22.9%	11
Other (please specify)	39.6%	19
answered question		**48**
skipped question		**0**

Question 2: Other (please specify)	
1	MCSC/PEO LS acquisition programs range from ACAT I down to AAPs
2	Not ACAT. Program is less than $3 million.
3	Non-POR
4	Non-Program of record
5	Project
6	Most Legacy systems don’t use SETR
7	One POR consisting of multiple abbreviated acquisition programs (AAP); ACAT III equivalent overall
8	AAP and an ACAT III program
9	ACAT 4 and Non-ACAT programs

10	Abbreviated Acquisition Program (most recent)
11	Smaller programs that support ACAT I-III programs
12	abbreviated acquisition systems
13	AAP
14	AAP
15	ACAT IV (T)
16	Not a program of record; an R&D program pre-milestone B equivalent to ACAT I
17	R&D Demonstration Program
18	Demonstration Program vice Acquisition program.
19	All ACAT level programs within PEO C4I go through some SETR events.

Question 3: What type of software acquisition model did this program leverage?		
Answer Options	**Response Percent**	**Response Count**
Commercial off-the-shelf	43.8%	21
Government off-the-shelf	8.3%	4
New Development	20.8%	10
Other (please specify)	27.1%	13
answered question		**48**
skipped question		**0**

Question 3: Other (please specify)	
1	Maximum use of COTS, with some defined use of GOTS.
2	Depends on the acquisition program
3	Non Program of Record (Non-POR)
4	Rapid IT Acquisition—COTS
5	In house Development years ago, Being maintained but not suitable to SETR, being phased out if they can ever find a COT fit (but is not advisable, at all, in my book).
6	A combination of COTS, GOTS, and new development followed by an Integration activity.
7	both COTS/GOTS
8	Mix of COTS (Office-type products), GOTS (For architecture), and New Plug-in Development
9	Maintenance of existing SPAWAR-developed software plus some new development.
10	Some new development with large amount of integration with COTS and GOTS
11	All of the above.
12	We deal with all of these activities.

13	I don't understand this question. On one effort we used the IT Box process, on others we tailored to meet our needs for the acquisition process.

Question 4: Did the program tailor the system engineering technical review process?		
Answer Options	**Response Percent**	**Response Count**
Yes	81.3%	39
No	18.8%	9
answered question		**48**
skipped question		**0**

Question 5: If applicable, which part did you tailor?		
Answer Options	**Response Percent**	**Response Count**
Review Order	13.6%	6
Reviews Included	70.5%	31
Entrance/Exit Criteria	65.9%	29
Not Applicable	15.9%	7
Other (please specify)	18.2%	8
answered question		**44**
skipped question		**4**

Question 5: Other (please specify)	
1	All of the above. Each acquisition program is unique and tailors it program based on many factors.
2	Those entrance and exit criteria that does not apply to non-ACAT or Non-POR.
3	Required Acquisition Documentation
4	Also combined multiple events into one (i.e. SRR/SFR, instead of two separate reviews/events); held "light" versions of various events (e.g., PDR, CDR) after major requirements and design overhauls
5	AAP tailored the entrance/exit criteria for all SETR events ACAT III has tailored all SETR events to the point where the effectiveness of events have been compromised.
6	literally everything. The existing SPAWAR SETR process is wholly overbearing and useless to line engineers. Had to rescope our review of contractor deliverables

	to a very simple Requirements Review + Initial Design Review (aka PDR) + Final Design Review (aka CDR) + Testing Review (TRR + Test Results all rolled into one).
7	Scope of documentation and reviews. The existing software was developed before the SETR process applied; thus, not all required documentation now required exists. Because the program is in sustainment, funding to retroactively develop the documentation is not available.
8	Applicable documentation. For my demonstration program the systems engineering process is focused on requirements definition with less focus on life cycle engineering as that is not prudent unless the program transitions to a full scale ACAT program.

Question 6: What reviews did the program include in the SETR process?		
Answer Options	**Response Percent**	**Response Count**
Build Technical Review	17.0%	8
Capability Build Review—Initial	4.3%	2
Capability Build Review—Design	6.4%	3
Capability Build Review—Readiness	6.4%	3
Critical Design Review	68.1%	32
Fielding Technical Review	17.0%	8
Functional Configuration Audit	27.7%	13
Integration Readiness Review	21.3%	10
Operational Test Readiness Review	36.2%	17
Physical Configuration Audit	29.8%	14
Preliminary Design Review	68.1%	32
Production Readiness Review	29.8%	14
Release Backlog Review	10.6%	5
SETR-Lite Engineering Review	14.9%	7
Software Specification Review	19.1%	9
System Functional Review	46.8%	22
System Requirements Review	70.2%	33
System Verification Review	36.2%	17
Test Readiness Review	76.6%	36
Other (please specify)	36.2%	17
answered question		**47**
skipped question		**1**

Question 6: Other (please specify)	
1	Flight Readiness Review

2	What SETR reference is being used for the list provided? Some programs create their own unique technical reviews. There are other SETRs that are not in the list provided.
3	System Requirements Review and System Functional Review were combined.
4	ATO, ATP, CRD, FOT&T, IBR, ILA, PD&E, RFI, RFP, UAT
5	Navy HR Pers/Pay systems have so many unique requirements that ongoing maintenance will be cheaper than conversion and the cost of new licenses, customization, upgrades, new licenses, re-customizations to the upgrades and that repetitive cycle over and over through time.
6	TRR was followed by independent component and integration testing.
7	Our initial Engineering Master Plan called out combining 2 SETR events into each review, with a total of 6 reviews.
8	AAP tailored entrance/exit criteria for SRR, PDR, CDR, PRR, FCA, SVR, PCA, TRR. ACAT III focus is on speed to capability and is using SETR-Lite Engineering Reviews to accelerate process.
9	The SRR and PDR was combined into a single event
10	Combined SRR/SFR
11	Non-Development Item Integration Review (NIR) in lieu of PDR/CDR for integration of COTS products.
12	USMC-specific Non-Developmental Item (NDI) Integration Review (NIR) which is comparable to a CDR but for NDI/COTS items. See MCSC Technical Review Handbook.
13	Other review were conducted, but not while I was on the project
14	NIR also included.
15	OTRR
16	Many of the elements of the non-implemented reviews are captured via quarterly program review events. Regular course check on technical progress vice milestone reviews. Also, contractors handle a lot of the systems engineering milestones at their level. Some reviews are held with government participation and insight, but not a government approval panel.
17	We also in what I believe is called an In-process review (I dont recall off hand but it is a mini review of the effort at a given time—between other SETR reviews). Not sure if that qualifies but it acts like a PMR but focused on engineering efforts.

Question 7: Which review events did the program find most valuable to assessing the technical maturity of the program?		
Answer Options	**Response Percent**	**Response Count**
Build Technical Review	4.2%	2
Capability Build Review—Initial	4.2%	2
Capability Build Review—Design	8.3%	4
Capability Build Review—Readiness	6.3%	3

Critical Design Review	56.3%	27
Fielding Technical Review	4.2%	2
Functional Configuration Audit	4.2%	2
Integration Readiness Review	12.5%	6
Operational Test Readiness Review	12.5%	6
Physical Configuration Audit	8.3%	4
Preliminary Design Review	39.6%	19
Production Readiness Review	12.5%	6
Release Backlog Review	4.2%	2
SETR-Lite Engineering Review	6.3%	3
Software Specification Review	10.4%	5
System Functional Review	12.5%	6
System Requirements Review	29.2%	14
System Verification Review	16.7%	8
Test Readiness Review	39.6%	19
Other (please specify)	12.5%	6
	answered question	**48**
	skipped question	**0**

Question 7: Other (please specify)	
1	Technical maturity is continuously assessed along the acquisition life cycle.
2	NSIPS was estimated to require no more than 15 to 20 to install initially, but required 90% change to implement. It has been required to upgrade with new licenses, re-customization, and requires a 30 day period to complete end to end testing of changes. Legacy can change in 1 to 2 days including testing all requirements. Navy Legacy HR data is on mainframe; not ever hacked, New systems want to use “cloud” technology, which can be hacked. Navy members should never be in a setting that is known to be easy to hack. Veterans/Service Members should know their HR data is safe, not subject to any hacking; veterans and current members deserve to have their data locked up and protected to the best of our ability to do that ! ! !
3	Our Program is still Pre-Milestone B (ATP) and in RFP release stage. We have only been through CDR and SRR. Our next scheduled SETR is not until Q2 FY19.
4	NIR
5	Did not find any valuable. Only time consuming.
6	Quarterly Program Reviews.

Question 8: What area of the program was adjusted based on the outcome of the SETR?		
Answer Options	**Response Percent**	**Response Count**

Cost	29.2%	14
Schedule	50.0%	24
Technical Design	52.1%	25
No change	22.9%	11
Other (please specify)	20.8%	10
	answered question	**48**
	skipped question	**0**

Question 8: Other (please specify)	
1	Various areas may be adjusted based on the outcome of the SETR. However, the outcomes are based on PM decisions since SETR close-out reports are from the program-independent SETR chair and to the PM. The SETR close-out report will include recommendations for the PM to consider.
2	Depending on what was going to be available or ready for delivery, what will be included in the release package.
3	Engineers want computers and computer science codified to engineering standards, and while some of those concepts apply, some don't. Computer science, to have as a tool for improving office systems and business systems is not the same as (similar, but different) computers for robotic type of situations, or warfare types of situations. No amount of training (in engineering steps) can replace a well qualified IS/IT/ADP top-of-the line specialist. Engineers will try to prove they can over and over, but that relies on the concept of saying one size fits all (which is true in some cases) which does not expand on the qualified IT Specialist's ability to adopt/adept/fits right, the needs of a business to a particular situation, i.e., Military HR PERS/PAY are unique but must be a fit to serve each service to fulfill the needs of all applicable laws Congress can pass.
4	Contract modifications occurred as result of the SETR Design reviews discovering that there was lack of interoperability with fielded capabilities. Additionally, the Design Reviews produced reprioritization of the interfaces.
5	System Requirements Specification
6	For ACAT III—no change for AAP—Cost, Schedule and technical design
7	SETR had no impact on what the PM wanted to do. He did what he wanted to do regardless of what the output of the SETR said.
8	Typically design was refined—not changed. Significant design changes occurred later during implementation that caused substantial delay. The NIR was treated by leadership as a check-in-the-box event rather than a substantial design review—perhaps the design issues could have been avoided if treated otherwise.
9	Cost more / schedule ended up much longer.
10	Reviews were so tailored in terms of entry/exit criteria, that the reviews were driven to ensure passing. This meant all risks associated were deemed "acceptable" and basically transformed into issues.

Question 9: By what percentage of the cost, schedule, and/or technical design was the program adjusted, if applicable?		
Answer Options	**Response Percent**	**Response Count**
0-20%	56.3%	27
21-40%	8.3%	4
41-60%	12.5%	6
61-80%	0.0%	0
81-100%	0.0%	0
Not Applicable	22.9%	11
answered question		**48**
skipped question		**0**

Question 10: Did any of the following options limit or create obstacles if the program tailored the SETR implementation?		
Answer Options	**Response Percent**	**Response Count**
Internal Organization	31.3%	15
External Organization	56.3%	27
Policy	18.8%	9
No limitation	12.5%	6
Not applicable	12.5%	6
Other (please specify)	16.7%	8
answered question		**48**
skipped question		**0**

	Question 10: Other (please specify)
1	It depends. For instance, if the PM/LSE uses a SETR event that senior leadership/ MDA is not familiar with, then it may result in additional exchanges between the PM and senior leadership/MDA to educate both sides until both sides agree on how it will be addressed and executed.
2	Every Navy 'Heavy-weight' that controls money in the budget thinks they can become a computer guru by buying the latest and greatest product that a salesperson can talk them into, and don't seem to realize that all requirements of ANY systems should be known PRIOR TO any purchase. Money to spend doesn't make a manager an expert, and they will be rotated out of that job in (usually) three years (or less) when someone else will come in and make decisions all over again. If you don't know how a present system runs (to fulfill all the laws, policies, required today), then how can you say that you are an expert qualified to replace that system. If you force the conversion on partial knowledge then the risk of failure increases

	and all members of that service suffer and Congress is unhappy. Why? Because they controlled the budget and had the authority but did not have sufficient knowledge, or training, or experience, to make the right call knowing the risks.
3	Personnel— The organization was not staffed with the appropriate number of people. Skillset -The work force was not trained for the positions they held.
4	PMW 240, as a portfolio of smaller programs, is built around the idea that the SETR process needs to be tailored for each, individual program; leadership is also aware that defense business systems, especially unmodified COTS implementations, are unique among DOD acquisitions, which necessitates modifications to the SETR process
5	The Program Manager did not and currently does not care for engineers. They "get in his way." Maybe that's why his program is failing...?
6	Actual SETR events were determined by MCSC leadership external to the Program Office.
7	There is very few tailoring guidelines. This leads to significant disagreement about what tailoring is acceptable. This problem exists at all levels. Take architecture for example: the DoDAF specifications are vague on tailoring, the Navy Architecture Development Guide does not directly address tailoring, and the SPAWAR architecture review guidelines (used by contractors to conduct reviews) make no provision for tailoring. Until tailoring is addressed directly at all levels from policy to review guidelines, attempting to tailor will lead to significant friction, frustration, and delays.
8	The external organizations (user and customer) were not involved in the review. Obstacles arose in the approval of a design that the user had never seen and making design decisions driving cost and schedule that the customer did not have input to change.

Question 11: Did the program include any metrics to assess the return on investment from the reviews?		
Answer Options	**Response Percent**	**Response Count**
No	80.9%	38
Yes (please specify)	19.1%	9
	answered question	**47**
	skipped question	**1**

Question 11: Yes (please specify)	
1	Development, Test, Cost metrics
2	This should be done on the operating for the thousands of PCs the Navy, of MS licenses versus the cost of Linux type (that can be make more secure than MS windows). We could save thousands, if not millions, or billions, and that money could go for personnel "perks," ships and weapon systems if only they looked at the long range rather than see how much of a budget they could control, or how much money (of that budget) they could obligate and spend!
3	Earned Value Management (EVM) Action Items tracking , Tailored Entrance and Exit Criteria Interface prioritization spreadsheet Testing Defects per build Functional and Nonfunctional Requirements per build
4	Initial business case and subsequent validation.
5	The SETR events were viewed as program milestones necessary for moving forward with the next phase of the project. Each SETR event resulted in RFAs that held the SETR event open until the RFAs could be addressed and answered.
6	AoAs were run at critical decisions in the program. COAs were used to provide the ROI and overall benefits or constraints. Selected COA implemented with MDA sign off.
7	We developed a comment review process that tracks comments using our CM tool (IBM JAZZ RTC). This allows stakeholders from all sides to see the number of comments, where they are in the adjudication process, and when stakeholders feel the review is ready to be closed.
8	The program had metrics set to meet threshold and objective criteria
9	When it came to combining reviews or merging them, then yes. In the past we have had several reviews skip the PDR and go to CDR due to multiple reasons. The view was that it would save on schedule and allow the team to progress to giving the requested solution to requirements vice systematically assessing as we progress through the engineering activities.

Question 12: Did the program have consistent leadership throughout a complete SETR cycle?

Answer Options	Response Percent	Response Count
Yes	55.3%	26
No	44.7%	21
answered question		**47**
skipped question		**1**

Question 13: Please provide any additional feedback regarding SETR implementations.	
1	Some of the questions set up as “yes” and “no” questions only and do not include other or alternative response. There were a couple of questions that I was not able to respond with either a “yes” or “no.” For question 11, there are metrics used but I was unclear on what was meant by ROI. For question 12, it was unclear what was meant by “consistent leadership” so I was not able to respond. Sorry.
2	Not sure if this is applicable to what you are doing. Projects supporting various customers, we follow the SIPH MILCON process.
3	SETR implementation is a good check and balance to see if processes in program is actually implemented as shown in progress.
4	SETR in static conditions is very good, but is not suitable for a situation where things can change too quickly, where laws and policies require ‘now’ (immediate) changes to meet any authoritative mandates dictated.
5	The program overestimated the value of the COTS product and tried to expedite the requirements phase. The program should have maintained a separate Requirements Review vice merging it with Preliminary Design Review.
6	SETR Events are usually of value added, but in an agile methodology / framework environments such events become challenging as the atmosphere changes dynamically and with an ad-hoc nature.
7	SETR events are not consistent throughout the organization. People attending the events have very little value to the process.
8	It’s difficult for Tech Warrant Holders to understand entrance & exit criteria for Business System SETR event because there isn’t a real tailored guideline or acquisition SETR schedule for large business system ACAT programs.
9	Functional community reluctant to adopt modern technology even when it was placed at their finger tips.
10	In my experience, SETR events often become a “check the box” sort of event if the program is required to complete every single SETR review, or even to address every single “bullet point” for a given review, regardless of how applicable it may be to the given program (if applicable at all). SETR reviews are absolutely necessary, but forcing programs to complete reviews that are extraneous given their specific situation leads to increased costs

	(especially on the part of the contractor, especially on smaller programs), schedule, etc.
11	The AAPs fell under P. Reddy and were done correctly. The ACAT-III can use some help, Most team members do not understand the intent or benefits of these events.
12	Need to have a stick to beat PMs over the head with IRT SETR. No SETR should equal a very bad FITREP or something. There just is no teeth to 5.0 type work and PMs can do what they want...and waste our tax dollars.
13	Tailoring SETR events has pros and cons. SETR events typically take a block of preparatory time and resolution time to address RFAs. This typically results in schedule delays. The benefit is that multiple SETR events ensure documentation is being updated as the program matures vice the documents becoming static and outdated.
14	Even though the program was an AAP, the SETR process provided disciplined engineering—that provided a product delivered on-time—however internal Navy interfaces and dependencies caused delays to the overall program. Those programs were NOT using SETR...
15	Tailoring provides a costs savings but the most difficult part is convincing a PM that is looking at a list that something is not needed or can be a simplified version.
16	While MCSC has a tech review handbook, different program offices seem to handle reviews substantially differently. Some program offices do a two week read ahead + 1 day review while others do a two week read ahead + kick-off + review period + comment adjudication period + capstone. In the latter case, tech reviews seem to stretch out for many weeks/months. We've captured that time in our process moving forward, but 8–12 weeks seems excessive for a tech review.
17	We have now moved to different leadership, with an increased focus on the administrative aspect of SETRs; participants are expected to review applicable documents outside of the actual review event. That does not happen—and assuming it will is setting us up for future issues.
18	I have none
19	It is extremely difficult to determine what is required. Even obtaining examples of good SETR documentation seems impossible. Because of this, it is difficult to feel prepared and reviews feel more like "gotcha events" than the assistance they are supposed to be.
20	SETR Is a great method to manage progress of programs
21	Program was post Milestone C, but not yet fielded when I joined the team. During my tenure, we achieved FOC.
22	Managing expectations & frequent sync sessions are critical to success. Ech 2 & Ech 3 have different interpretations of what is expected regarding the level of completeness of each SETR. Often Ech 2 is more concerned about a check in the box than ensuring the engineering products are really useful.
23	I have the brief for the Agile/SETR process that programs have had success in using. However, not all programs are allowed to use that brief. That is

	due to external organization and not ours.
24	I am referring to CANES and the DOT&E oversight of the program.
25	SETR process was a good framework for tailored acquisition, but still new to the external stakeholders. This created the need to educate people more on the modification from the norm.
26	For a smaller demonstration type program, filling in the gaps created by tailoring with the routine program reviews has worked well. A lot of the same things are covered, but in a more flexible construct.
27	There is often a disconnect between the cost and schedule of a program and the goal of the SETR which is more focused on performance. Performance is often the bill payer for cost and schedule.
28	I have been a part of many types of reviews over the years. Depending on the effort, the tailoring was handled differently each time (except for the PDR, 9/10 times it is merged into CDR). I treat that action as Leadership's view to handle SETR reviews and a vision that the workforce is really just hardware integrators vice engineers (no real development effort, just repackage existing components).
29	While SETR is a great tool to assess where a program is in the time of the event. We are normally limited in time and resources on how deep to conduct the review. We are also limited to the information that the programs provide. I had an instance where the performers provided all the necessary information, everything appeared on schedule for delivery and the SETR went by smoothly. I later found out that the performers were 11 months behind schedule, but this was not apparent with the provided documentation. While SETR is a good tool, it is often cumbersome to the programs to support this effort while still performing their daily tasks.
30	SETR should be a means to implement engage users and customers and vet risks before they become issues.

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